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Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. FRANCŒUR. *Translated by* W. H. EMORY, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 23.]

Book 2nd.—Geomorphy.

GEOMORPHY, more commonly called GEODESY, is the science which treats of the measurement of the earth, and its great territorial divisions. The results in geomorphy are obtained by observations and calculations. Therefore, as a preliminary step, it is necessary to be made acquainted with the instruments which are used, and the formulas applicable to the observations made with them.

For this reason, we shall commence by giving the theory of these formulas, and a brief description of two instruments with which the observations are usually made. The theory of these formulas, which are of constant application, is comprised in the article on *spherical trigonometry*.

Operations in geomorphy consist in the measurement and calculation of angles and distances on the surface of the earth, and in the observation of stars, to determine from them the relative position of places. Hence the two great divisions of the subject into *terrestrial* and *astronomical geomorphy*.

The terrestrial operations consist in covering the whole ground to be explored with a series of triangles, the angles of which are measured with an instrument, and the sides calculated; one of the sides

being taken as a *base*, and measured by direct means. After this is done, we can derive from it the extent of the terrestrial arcs which lie within these triangles, such as the *meridian*, and the *parallel of latitude*. These arcs being known, serve to determine the ellipsoidal form, and the dimensions, &c., of the terrestrial globe.

The astronomical operations enable us to find the *longitude* and *latitude* of stations, the *azimuth* of the sides of triangles, the variation of the needle, &c.

Many other subjects are treated of in this book besides those enumerated, which are immediately applicable to geodesic operations. Some of which are—

1st. The oscillations of the *pendulum*, which furnish very useful data in determining the oblate form of the earth.

2nd. The elevation of points which are taken as geodesic stations, or in other words, the method of *leveling*.

3rd. The art of representing by figures the results arrived at by the foregoing methods; that is to say, the art of composing a *geographical map*, which enables the eye to embrace, and compare, at the same time, all the details; for it is not sufficient for the purposes of geography, to have merely the numerical values deduced from the determination of the sides of the triangles with which we cover a district of country to be surveyed.

Chapter II.—*The Repeating Circle.*

The repeating circle gives results with great precision, and is the most ingenious of all the instruments used in measuring angles. Since its invention by Borda, the large instruments used for terrestrial and celestial observations, the weight of which rendered their transportation and management so difficult, have been abandoned. Experience has shown that results can be obtained quite as accurately, and with much more rapidity, with a repeating circle of about three decimetres, [11.8113 inches,] in diameter. Figures 58 and 59 are representations of this useful instrument. In describing it, we limit ourselves to essential details; for the component parts are too complicated to be represented precisely by drawings. An examination of the instrument itself is the most satisfactory means of obtaining a knowledge of it.

We will give first the principles upon which the construction of the repeating circle is based.

93. It is a circle mounted on a tripod with a universal joint, by which it can be adjusted in the plane of any two objects between which it is proposed to find the angular distance, that is to say, the angle formed by visual rays drawn from the centre of the circle to

these objects. This circle turns on an axis perpendicular to its plane, and passing through its centre; so that in every position it takes in revolving about this axis, the objects, or signals, will be in the prolongation of the radii of the circle. This circle carries two telescopes movable around its centre; one of them, A A', (figs. 58 and 59,) above the limb, and the other, B B', below it.

The telescope A A', can be directed to any one object in the plane of the limb, and the telescope B B', to any other in the same plane, without moving the limb; the tubes of both telescopes revolving around its centre. It follows also that the circle, or limb, can revolve about the same axis, carrying with it the two telescopes. Each of these three movements is provided with a clamp and a tangent screw.

The construction of the telescopes will be described hereafter; for the present, it is sufficient to say that they are made with a magnifying power as great as the dimensions of the instrument will admit, and that in looking into the telescope we see two very fine threads intersecting each other at right angles, one parallel, and the other perpendicular, to the plane of the limb, with the point of intersection in the axis. To make an observation with the telescope, it is moved until the object is found in the optical field; this done, the delicate movements are produced, and the intersection of the threads brought in coincidence with the object by means of the tangent screw.

94. The limb is divided into degrees, half degrees, or less, according to the diameter of the instrument; usually, it is divided into divisions as small as five minutes. The upper telescope A A', has a vernier attached to it, which slides along in contact with the divisions of the limb. This vernier enables the observer, by the aid of a magnifying glass, to read the fractional parts of a division.

The theory of the vernier was explained in article No. 9; it was there shown that when an arc of the vernier, equal to $n - 1$ parts of the limb, was divided into n number of equal parts, the space occupied by each division of the vernier was smaller than those of the limb by the nth part of the divisions on the latter. If, for example, the limb is divided into 360 degrees, and each degree divided into six equal parts, each part will be 10 minutes. If an arc of the vernier, equal to 59 of these divisions, be divided into 60 equal parts, each division of the vernier will be $\frac{1}{60}$ or 10″ smaller than those of the limb, and consequently the limb can be read to 10″.

95. The upper telescope being placed in any position whatever, if we wish to read the corresponding graduation, we commence by reading the number of degrees, and the divisions of tens of minutes; then, if the zero point of the vernier falls between two divisional lines

on the limb, (as frequently happens,) there remains to be read on the vernier the fraction corresponding to the interval between the zero point of the vernier and the preceding divisional line of the limb. For this purpose, we observe what divisional lines of the vernier and the limb are in exact coincidence; then counting the number of divisions from this point to the zero point of the vernier, the number so obtained, multiplied by 10," will be the fraction required. To save the trouble of counting, these divisions are numbered, so that the number of minutes and seconds to be added to the first reading are indicated on the vernier.

The lower telescope does not move in contact with the divisional lines of the limb, and does not carry a vernier; its use will soon be explained.

96. The circle being mounted on the stand, and the limb being in the plane of the two signals, we fix the upper telescope on the zero of the graduation of the limb, and turn the circle upon the axis which is perpendicular to it, until the point of intersection of the cross hairs in the telescope A A', is in coincidence with one of the signals L, (fig. 61.) The telescope is still fixed on the zero point of the limb. Fixing the limb in this position, direct the lower telescope upon the other object, K, to the left. The angle A C B, formed by the optical axes of the telescopes, is evidently the angle formed by visual rays from the centre of the circle to the two objects. This angle is measured by the arc A B of the circle intercepted by these two rays. But the telescope B B', being below the limb, we cannot read the graduation.

Then turn the circle, and with it the telescopes, until the lower telescope, which was directed on the object K, situated to the left, takes the direction C A, on the object L, to the right; the upper telescope will thus be made to take the position C D, and the zero of the graduation on the limb will be moved from A to D. The value of the arc D A = A B, is the result required.

The circle being in the position last described, clamp it; then unclamp the upper telescope, and direct it on the object K, to the left. The angle B C A = A C D, is the one required; but the angle D A B, which we read on the limb, is double the required angle, it is therefore divided by two.

Repeat this double observation, by taking the point B, on the limb, as the point of departure, that is to say, turn the circle, together with the telescopes, until the upper one, which was in the position B B', takes the position A A', on the line of the right hand object; the zero of the graduation is thus moved from D to E, and the lower telescope passes from C A to C D. Now detach the lower telescope, and turn it (the limb being clamped,) until it is brought back on the object K,

to the left, and the arc E B, will be triple the arc A B. Repeat again the same operation, by clamping the telescopes, and turning the limb until the lower telescope is directed on the object L; the zero of the graduation is thus removed to F. Then detach, in its turn, the upper telescope, which is at C D, and move it until it is directed on the object K, to the left, and the arc F B, read on the limb, will be quadruple the arc required.

If we go on in the same manner, and make ten observations, the angle will be decupled. There is no necessity for reading the graduation at every observation with the upper telescope; it is sufficient to read the arc obtained when all the observations are completed.

We will now examine the advantages of measuring angles in this manner.

97. It is evident that if the upper telescope is brought back to the zero point of the graduation after ten observations, the sum of all the arcs is 360°, and each arc is 36°, and that the result is exempt from errors of eccentricity in the movement of the telescopes, and the errors in the division of the limb. It is proper to add that it seldom, if ever, happens in practice, that the upper telescope returns exactly to the zero point of the graduation; but if we find, after making ten observations, that the arc decupled is made 320° by some error of the instrument, when it should have been 320° 5′, we see that by dividing by 10, we get 32° instead of 32° 0′ 30″, and that the error is reduced from 5′ to 30″.

98. The repeating circle, when used with care and skill, has then this great advantage, that it diminishes the errors resulting from imperfection in the construction of the instrument, almost indefinitely. Besides, it lessens the errors resulting from not placing the cross threads and signals in coincidence.

To remedy the errors of eccentricity in the axis, it is customary to have two verniers attached to the superior telescope, diametrically opposite each other. The graduation of the limb corresponding to both verniers is read before commencing the observations, and after finishing them, for the purpose of seeing what space is passed over by the telescope; these arcs, if not exactly equal, will be nearly so, and the mean between them is taken. In the best instruments of this description, four verniers are used, placed at right angles to each other, and divided to read arcs of 5″ with exactness.

99. After what has been said, it is easy to form an idea of the construction of the repeating circle, (fig. 59.) The column S, is made with a slightly conical cavity in its longitudinal direction, in which the central axis of the instrument is inserted. This axis is of steel, and is firmly attached to a graduated circle, or plate, O. The column S

carries with it the circle M M, which, with its telescopes, turns about this steel axis, its motion being stopped by the clamp screw O, which clamps the arm attached to the column S, to the lower plate O. The angular value of the general movement of the instrument about the axis can be read on this plate. The column should be adjusted exactly upon the axis of the central shaft, in order that the movement may be smooth and exact.

The plate carrying the axis is supported by three screws, *v v' v''*, which rest on the table N N. These screws are used to give slight inclinations to the column S. The table N N, is supported by three stout wooden legs, and in a prismatic opening in its centre a rod of the same shape is fitted, by raising or lowering which the table is raised or lowered to a convenient height to suit the observer. The circle is supported on the top of the column S, by an axis V, around which it revolves. This motion about the axis is stopped by a clamp screw P, which presses against a piece of brass in the shape of the quadrant of a circle, embracing the axis V.

To place the limb in the plane of two objects, the movement given to the column by the screws *v v' v''*, is combined with the movement of the circle about the axis V.

Some of these instruments are constructed with two axes perpendicular to each other, about both of which the circle may turn. The circle is easily placed in the plane of two objects by a combination of these two movements. In this construction, the column S, remains upright.

The vernier is usually attached to a circle carrying the telescope, and concentric with the graduated limb. This circle and the limb are apparently united. The faces of both are in contact, and in the same plane, and turn about the same centre. Each circle is supported on the axis by 6 or 8 spokes; the exterior one is divided on its inner side into 360°, and the interior one carries the verniers.

Perpendicular to the plane of these circles, and in their centre, is a steel axis, around which the two telescopes A A', B B', revolve. Figure 59 shows the manner in which these telescopes should be arranged to be free and independent in their movements. This steel axis, or shaft, penetrates the centre of the bore of a cylinder which passes through the piece V, and is soldered to the centre of the *drum* T. When this drum is turned around its axis from X, towards T and Z, the vertical motion being stopped by the clamp screw P, it carries with it the limb and the two telescopes, without moving them from the plane of the two objects. The periphery of the *drum* is cut into notches, into which an endless screw works, and communicates slight motions to the limb in its plane. This screw is pressed against by a

steel spring, which being removable, the screw can be disengaged, and large movements communicated to the limb by the hand. The shaft of the drum should be exactly concentric with the limb and the arcs of the verniers.

100. To use the repeating circle, first place the limb M M in the plane of the two objects. Then, place the upper telescope on the zero of the graduation; disengage the drum T from the endless screw and revolve the limb until the upper telescope is directed on the object to the right. When the object is seen in the field of the telescope, re-attach the endless screw, and complete the contact of the object and cross hairs by the small movements of the drum. While this is being done, a second observer directs the lower telescope on the object to the left, and brings it in coincidence with the cross hairs. We have thus the first observation. One observer can perform both of these operations by doing them in succession, but with two the labour is abridged.

The 2nd observation of the angle is made by detaching the drum and turning the entire circle without detaching the limb, carrying with it both the telescopes until the lower telescope is directed towards the object to the right; at the same time the 2nd observer detaching the upper telescope, directs it towards the object to the left. When the first observer completes the coincidence of the cross hairs of the telescope with his object, by means of the drum-screw, the second observer completes his by the use of the tangent screw of the telescope. In the same manner the third, fourth, &c. measurement of the angle is made, each operator observing always on the same objects, but alternating with the telescopes. The arc indicated by the final observation is then divided by the number of measurements, and the quotient is the arc required.

101. It is frequently necessary to find the *angular height of a signal*, that is to say, the angle which a visual ray from the observer to the signal makes with the horizon. This angle is the compliment of the angle which the same ray makes with a line from the observer to the zenith.

To measure the zenith distance, give the repeating circle the position represented in figure 58, by turning the drum on its shaft. Care must be taken to place a weight on the drum sufficient to counterbalance the weight of the limb and telescope, so that the centre of gravity may remain in the axis of the column S, which is placed exactly vertical. The last condition is attained by means of the spirit level, and the screws v v' v'', as will be explained hereafter.

Suppose now that the column and limb are exactly vertical, so that when the circle is turned, its plane shall be vertical in all its positions. The circle in figure 62 is supposed to represent the limb of the instru-

ment in one of these positions; the upper telescope is directed towards a signal H, the zenith distance of which is required. This distance is the angle formed by the visual ray C A with the vertical line C D. We suppose that the telescope has first been fixed at A upon the zero of the graduation, and that it has been directed on H by turning the drum in its plane, the column remaining fixed to the lower plate by the screw H, (see fig. 58.)

The instrument being in the position described, the screw H is loosened and the limb is turned with the column 180°. The telescope A' A will then take the position E' E, (fig. 62) and the zero point of the graduation the place E. But the line D D' will still remain vertical as the revolution is made about this line as an axis. Thus the angle to be measured is E C D. Detach the upper telescope and direct it exactly on the signal H, without deranging the position of the limb. It is evident that the arc A D is the one to be measured, and that the arc A E, described by the telescope is double the zenith distance required. This done, by turning the circle again, together with the shaft to the opposite side, the telescope returns to the position E E' and the observation is repeated as often as desired.

In this operation the lower telescope is no longer of any use, except to test, by means of a spirit level Q (fig. 58) fixed to it, the vertical position of the column, or rather of the diameter D D', after revolving the circle about it. This is done in the following manner:

102. After placing the limb and the column vertical, and fixing the telescope A B upon zero, turn the instrument about the column until the limb is in the vertical plane of the object: clamp the column by the screw O, and direct the telescope, which remains fixed at zero, upon the object by turning the limb on its horizontal axis by means of the drum screw. When the cross hairs and the object are in exact coincidence, turn the lower telescope, and by using its tangent screw, bring the bubble in the middle of the glass. Loosen the screw H and turn the instrument around the column S 180°, measured on the circle O. In this position of the instrument the object is still in the vertical plane of the limb, but on the opposite side.

The bubble should now be between the marks indicating the middle of the glass; if it is not, bring it to this place by turning the drum-screw, being careful not to touch the telescope or its tangent screw. Then detach the upper telescope and direct it on the signal: the angle passed over will be double the zenith distance. Observe exactly the place occupied on the limb by the upper telescope, which serves as a point of departure for a second observation. The second observation is conducted like the first, and repeated until the bubble remains in the middle of the glass in both positions of the instrument.

Fig. 58.

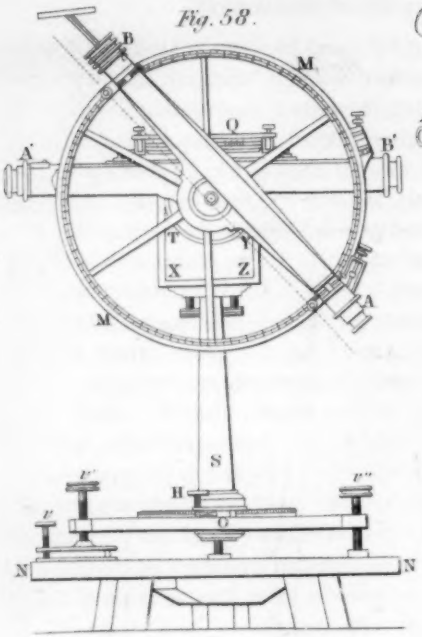


Fig. 59.

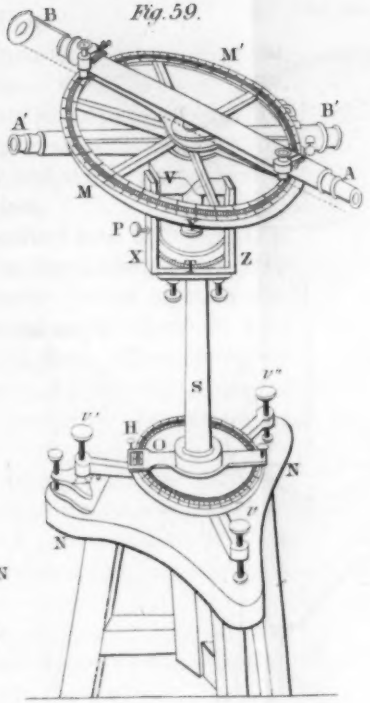


Fig 70.

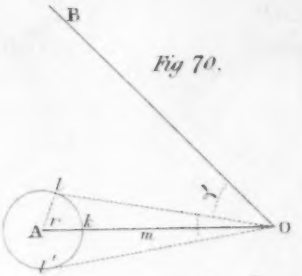


Fig 76.

Fig. 77.

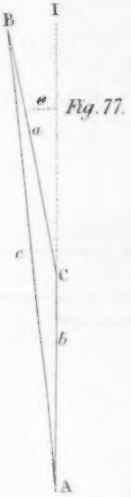


Fig. 61.

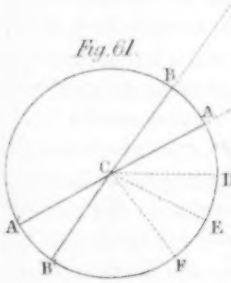


Fig. 62.

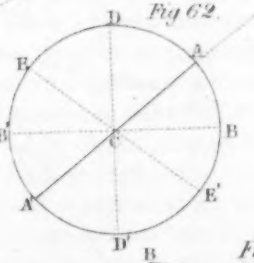


Fig. 63

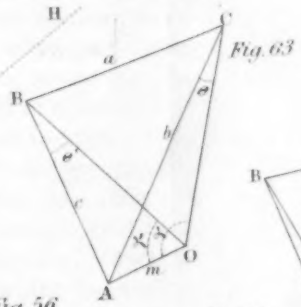


Fig. 65.

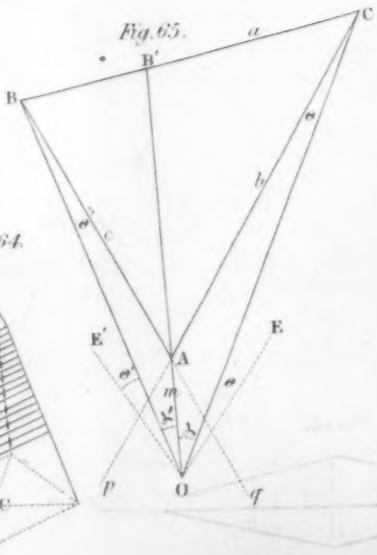


Fig. 67.

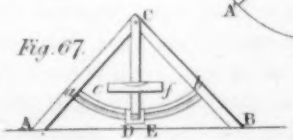


Fig. 56.

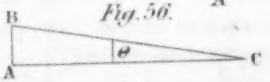


Fig. 64.

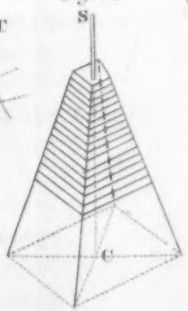


Fig. 57

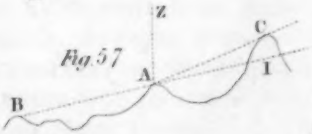
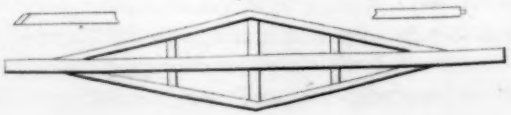


Fig. 68.



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The repeating circle is made of brass with steel screws, and in order that the divisions of the limb and the verniers should be very clean and neat, they are made upon a circle of gold or platinum embedded in the brass. For the purpose of reading the graduation with facility, a magnifying glass is placed at each vernier, and the divisions are protected from the reflected light by ground glass.

103. The telescopes are formed of a cylindrical tube with a glass at each end. The *object* glass, or that towards the object, should be convex and achromatic; that is, formed of two glasses joined together; the density of the interior one should be increased by oxide of lead to prevent the image being colored by foreign tints. The object glass should be as large as is convenient to receive as many rays from the object as possible. It unites these rays at a point in the axis of the tube near the other extremity, called the focus, and forms there a well defined image of the object. At this end the eye-glass is placed, near to which the eye is applied. The eye-glass is very convex, and serves to magnify the image which the object-glass makes at the focus. This focus should be common to both glasses, and very near the eye-glass, which is smaller and more convex.

The eye-glass is fitted to a small tube which can be pushed in or out for a short distance, depending upon the vision of the observer, until a clear well defined image of the object is perceived.

The interior of the telescope is furnished with diaphragms opened in the centre, to exclude the scattering rays of light, which destroy the distinctness of the image. Their oblique direction, producing the aberration of sphericity, causes them to be projected at different foci. At the focus of the object-glass is a diaphragm with an aperture, carrying threads of silk or cobweb crossed at right angles. As these threads should be exactly at the focus of the object-glass, and as the position of this focus changes a little, according as the object is nearer or farther removed, the threads should have a motion along the tube. This condition is essential: for if the threads are not exactly at the focus of the object-glass, they will not appear stationary with regard to the image when the eye is moved a little up or down. This is called the *parallax of the threads.* When this defect exists, there is no certainty that the telescope is directed on the object. However, when the object is very far off, a greater or less distance does not sensibly change the focus of the object, and the threads once properly placed do not require to be changed while observing on distant objects.

It is almost useless to say that when the position of the threads is changed, that of the eye-glass must be changed also, so that the image and the threads may both be seen with distinctness. The object-glass remains always stationary. Thus we commence by bringing the cross

hairs to the focus of the object-glass by successive trials, examining each time to see if there is any parallax of the threads, which is done by observing whether the relative positions of the threads and the image appear to change when the eye is moved up and down before the eye-glass. When there is no change there is no parallax, and the tube carrying the eye-glass is moved until the image and the threads are seen distinctly.

These telescopes reverse images, but no inconvenience results from it. Their optical axis should be exactly parallel to the limb.

104. The *spirit-level* is formed of a glass tube containing alcohol, hermetically sealed at the ends. The tube is not quite filled with the liquid, and the space left is called the bubble. Alcohol is used because it does not freeze and break the glass. Care must be taken to give the interior of one of the sides of the tube a circular form; without which the slightest motion will make the bubble pass from one end of the tube to the other without being able to make it rest in the middle. This is done by the friction of sand and emery. For protection, the glass is encased in a brass tube opened on the upper side. Equal divisions traced on the glass and numbered, serve as marks to show if the bubble is in the middle of the tube, for the length of this bubble diminishes by heat which expands the fluid, and contracts by cold, in a greater proportion than the glass. The maker adjusts the tube in its box, so that the bubble will be in the middle when the axis of the tube, or the part of the instrument to which it is attached, is horizontal.

These spirit-levels properly adjusted and placed, serve to test the perpendicular position of the column of the repeating circle, the horizontal position of the plate, and the vertical position of the limb. The manner of adjusting and using them will readily occur to the reader. The art of constructing the glass tube has been brought to such perfection that the inclination of the plane can be calculated, corresponding to the motion of the bubble along the tube of 1. 2. 3. . . millimetres [0.03937, &c. inches], so that it becomes in fact a *slope level*, by which the inclinations of planes can be determined in seconds.

[TO BE CONTINUED.]

Notes on Belgium. By CAPTAIN G. W. HUGHES, *United States Topographical Engineer. Addressed to* FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington, D. C.*

CONTINUED FROM PAGE 83.

After having seen every thing worthy of attention at Seraigne we left in the diligence for Namur. The valley of the Meuse has been

often compared, but the English think without reason, to the picturesque scenery of the Wye. To me it seemed even more lovely than that beautiful region. The valley of the Meuse is narrow but cultivated like a garden to the hill tops. When the slopes are too steep to retain the soil they are divided by stone walls into several terraces, and where the exposure is favorable the vine is grown. It does not, however, produce good wine, the best of it not being much superior to the *vin ordinaire.*

"Stern visaged war" has indelibly impressed his rugged features on this lovely vale. The villages, chateaus, churches, roads, walls and bridges, all seem to have been constructed for purposes of defence—every house is a fortress and every yard is an advanced work. Each beetling cliff is crowned, and the whole country appears clad in complete panoply of war. At Huy (pronounced *we*) the road crosses to the right bank of the river over an ancient stone bridge, and passes directly under the walls of an old cathedral, and the citadel which commands the Meuse above and below. It was repaired and enlarged by the English in 1816, and is regarded as one of the strongest works in this land of fortresses. The rock on which it stands is literally covered with the vine. Near Huy, the old sandstone first makes its appearance, overlaying the transition limestone, (which abounds with caverns.) From Huy to Namur the valley becomes very narrow, and the naked and jutting rocks present an imperfectly columnar appearance, having been much disturbed, and at a distance, somewhat resemble the palisades of the North River.

Feb. 17th. Went to-day to examine the celebrated Citadel of Namur, situated on a narrow rock at the confluence of the Sambre with the Meuse. This is a most wonderful work, and has been called the Gibraltar of Belgium. Wall after wall, rampart after rampart, fort after fort, surrounded with wide and deep moats (scarped and counterscarped, and broken up with traverses,) and all connected with covert ways, bomb proof and loop-holed, and subterranean galleries, rise from the level of the rivers to the height of nearly 600 feet, on which stands the citadel, with its faces, flanks and curtains completely casemated. Its trace is irregular, but conformable to the contour of the ground, or rather rock, on which it is built, and with which it is incorporated. On the very highest part of the bridge is an advanced work, designed by the Duke of Wellington, and executed at the expense of the British government. This advanced work is built on a deposite of iron ore and imperfect coal, which is not permitted to be worked.

It strikes me that this fortress, like every other similar work in this part of the world, is placed *too high* for its principal design, which was the defence of the valleys of the Sambre and Meuse; but as it regards

its own defence, I should think it as nearly impregnable as human skill can render any naturally strong military position, and that it could not be reduced except by a long continued blockade. Its casemates are seven feet thick at the crown of the arches, and it is surrounded by galleries and mines, while an abundant supply of water for a numerous garrison, rises within its walls. The bridges across the river are both fortified, and the city is a walled town.

It must not be forgotten by the traveler, that here "Uncle Toby" distinguished himself at the Forte St. Nicholos, and it was here "our army swore so terribly," an accomplishment which seems to have been legitimately handed down in the military line to the present day.

Namur is celebrated for its cutlery, and has been called the Sheffield of Belgium. I visited one of the largest cutlery establishments in this city, and was highly gratified with what I saw. I remained long enough to see every process from the forging of the knives to the finishing and packing them. The *tempering* of pen knives, scissors and razors is accomplished by heating them to a certain degree, obvious only to an experienced person, and then dipping them in cold water. Lancets are tempered in cold tallow, and table knives in oil. This imparts more elasticity to the metal than it receives from the other processes.

Belgium abounds with coal and iron mines, marble quarries and building materials of various kinds, and the working of these minerals occupies a high rank among the great interests of the kingdom.

The mining territory of Belgium may be regarded as divided into three districts. The first includes Hainaut and consists of 155 mines, underlaying 256,000 English acres. The second is situate in the Provinces of Namur and Luxembourg, and contains 59 mines, underlying 75,000 acres, and the third embraces the Provinces of Liége and Limbourg, has 138 mines, under 80,000 acres: making in all 352 mines, underlying 411,787 acres, or 66 square leagues of 5,000 metres.

Of the mineral riches, coal (houille*) is regarded as the most important, the more especially as the country, excepting the mountainous districts of Ardennes, is almost destitute of any other species of combustible, and it not only supplies nearly the whole of Belgium with fuel, but a large quantity is annually exported to France from the Southern Provinces, Hainaut alone producing more coal (charbon de terre) than the whole of France.† The four central collieries of Mons, Morimont and Liége yield annually 3,200,000 tons (of 1,000 Kilo-

* This term is, I think Walloon. The Walloon dialect is very similar to the ancient, and now very nearly obsolete, French language.

† In France 198 mines are worked, employing 17,500 miners, and yielding 60,000,000 of bushels of coal, or about 2,000,000 of tons (of 1,000 Killogrammes) valued at $3,600,000.

grammes—the kilogrammes being equal to 2.20548 lbs. avoir dupois). In 1836, 456 pits were worked for coal in 250 mines, and gave employment for 31,196 workmen, producing 96,000,000 of English bushels, valued at more than $6,000,000. The price per ton at the pit's mouth was in 1837 at Charleroi from $3.75 to $3.50, and at Mons, from $2.50 to $2.75, and the prices at present are very nearly the same on an average. The cost of mining a ton of coal at Liege, is but little less than $2.00. The State owns a colliery called Kerkroade, in Limburg, the rents of which per annum amount to about $50,000.

In Flanders, Luxemburg, and some other localities, turf is used for fuel, and at Antwerp, Bruges and Ostend, English coals are consumed, as they are imported free of duty.

The following analyses of Belgian coals have been kindly furnished me by the Director in Chief of Mines, Mr. Canchy. A mean of several of the best coals gives the following results, viz:

	Spec. gr.	carbon.	hydrogen.	oxygen.	azote.	cinders.	Remarks.
1st.	1.276	84.67	5.29	7.00	0.94	2.10	These are called *fat* coals, 'le houille grasse á longue flamme.'
2nd.	1.292	83.87	5.44	7.00	0.03	3.68	

He says that no Belgian coals are employed in their natural state for the reduction of iron ores.

I am indebted to Major Frederickx, of the Royal Foundry, for the following analyses of five specimens of coal from the left bank of the Meuse, in the Province of Liege, by C. Davreux.

Major Frederickx observes that the specimens Nos. 1 and 2 are the best combustibles of Liege, and possess great calorific powers, and are generally employed in the reverberatory furnaces. Nos. 3, 4 and 5 are inferior in quality, and are used for ordinary smith's work, and for generating steam.

Specimens,	1	2	3	4	5
Carbon,	0.783	0.760	0.699	0.726	0.685
Ashes,	0.039	0.044	0.067	0.032	0.103
Volatile matters,	0.178	0.196	0.234	0.242	0.212
	1.000	1.000	1.000	1.000	1.000

1 and 2 coal from the mine of Marair of Ste. Marguerite.
3 " 4 " " " " *Olisson* au val Benoit.
5 " " " " Cerisier a la Haye a St. Gilles.

Analysis of Mineral Coals from the district of Mons, by Berthier.

FAT COALS.

	1	2	3	4
Carbon,	0.715	0.653	0.585	0.510
Ashes,	0.052	0.017	0.030	0.050
Volatile matter,	0.233	0.330	0.385	0 040
		1.000	1.000	1.000
* Lead with litharge,	1.000	29.0	28.1	27.4
Carbon equivalent to the volatile matter.	}	0.22	0.24	0.30

* "Plomb avec la litharge."

No. 1. Coal from the Canton of Dour. Fragile, of a homogeneous blackish colour without being earthy. Its density is 1.27, and it yields from 0.65 to 0.68 per cent. of excellent coke.

No. 2. From the *Vein of Bouleau—Fontaine-Madame*, near Mons. Its density is from 1.260 to 1.287; it yields 0.55 per cent. of "beautiful coke."

No. 3. From the Bed of Grand-Gaillet.

No. 4. From the Gade Vein. The coke of this coal swells very much, (tres boursoufflé) and is light and porous. The coal is admirably adapted to the generation of gas.

Composition of the dry, or anthracite coals of Mons.

Carbon,	0.850
Ashes,	0.023
Volatile matter,	0.127
	1.000

Mr. Dumont says, "the combustibles employed for the reduction of metallic ores, are coke and charcoal. In Ardennes they use carbonized wood, (le bois torrifié.)

No copper is reduced in Belgium, but a great deal of brass or yellow copper ("cuivre jaune") is manufactured, and also of bronze; but it is difficult to ascertain the precise amount of the annual production.

The following coals from Liege are by M. Delvaux of the School of Mines:

No. 1. A slaty coal, easily broken and of splintery fracture. It is from the colliery of "l'Arbre St. Michel," commune of *Harion*, Hozemont, and was taken from the "Dure veine," or hard vein. Its coke is greyish and brilliant; its density 1.365, yields 91.0 of coke; its calo-

rific power 7861.4; the equivalent of carbon to volatile matter 0.18629.

Composition.

Carbon.	Ashes.	Volatile matter.
81.9	9.10	9.00=10.000

No. 2. Fragile, schistose, lustre resinous, from the colliery of Baldaz-la-lore, commune of *Chokier*, and bed *Petite Hareng*. Density 1.286; coke very much swelled, (tres boursoufflé), of which it yields 83.67.

Composition.

Carbon.	Ashes.	Volatile matter.
71.68	11.96	16.36=100.00.

No. 3. Schistose, lustre resinous, from the colliery of *Bonnier*, bed *Moset*. Its density 1.318. Coke pulverulent, of which it yields 92.00.

Composition.

Carbon.	Ashes.	Volatile matter.
91.388	0.612	8.00=100.00.

I have been at some trouble to obtain these results, in the hope that they may be rendered useful, as a means of comparison between our ores at home and those of foreign mineral productions.

Iron mines are very common in this country. The ores closely resemble in organic composition, those of France; they contain nearly the same elements, and produce iron of almost the like quality, but the French iron brings generally the highest price in market, which may be owing, in a great degree, to its being reduced with charcoal.

There is perhaps no country in Europe of the same extent, that contains more iron ores and a greater variety of them, than that between the Sambre and the Meuse. It is this district which furnishes the minerals for the furnaces of the Sambre, and partly for those of the Meuse and Liege. Besides this district there are a great number of mines worked in the Provinces of Liege, Limburg and Luxemburg. In 1836, the blast furnaces consumed 456,000 tons of worked iron ore, being about one half of the unworked ore as it is extracted from the earth. The ore is worked to free it from the earthy matter, which adheres to it. The consumption has greatly increased since 1836, but I have seen no authentic returns of the present amount.

I am indebted to the superintendent of the Royal Foundry for the following analysis of iron ores employed at the foundry. He says, "I regret not having been able to obtain analyses of all the iron ores employed in the reduction of the iron used for the fabrication of cannon at the Royal Foundry; but I send you the results of four specimens of

the best ores, which produce a very strong iron. The other ores do not differ materially in composition from them."

Analysis of four specimens of hydrated oxide of Iron from Hotbomont, near de Theux, Liége, by C. Davreux.

Specimens,	1	2	3	4
Peroxide of iron,	0.839	0.804	0.732	0.591
" " manganese,	0.023	0.036	0.099	0.115
Silex,	0.031	0.039	0.035	0.103
Alumine,	0.000	0.008	0.012	0.050
Lime,	0.000	a trace	0.003	0.007
Water,	0.107	0.113	0.119	0.134
	1.000	1.000	1.000	1.000

Mr. Cauchy, the Chief Director of Mines, says that there are two very distinct species, or classes, of iron ores. The one a *red oxide*, extremely rich, but yielding a brittle iron, owing to the presence of phosphoric acid—the other a yellow and brown hydrated ore, yielding not more than 30 or 40 per cent. of metal, in consequence of its being very argillaceous, but the iron is of an excellent character and very strong.

I am indebted to Professor Dumont, of Liege, (at the instance of M. Juetelet, perpetual Secretary of the Royal Academy of Brussels,) for the following analysis of iron ores.

Analysis of the Limonite, (Hydrated Oxide of Iron,) from the Angleur Mine, near Seraigne. By Professor Le Soinree.

This limonite is zinciferous.

10 grammes* of crude ore = calcined ore,		8.30
We add for a flux, Argile,		1.00
0.8 carbonate of lime = quick lime,		0.45
Total of fixed matter,		9.75
We obtained of pig iron, 4.52,		
of scoria, 1.63,	=	6.15
Loss in oxygen and oxide of zinc,		3.60

The solvent, or flux, (le fondant,) was 1.45. There remain for the vitreous matter of the ore, 0.18, and the zinc was entirely volatilized. The iron was gray, and of a good quality.

* The gramme is = 18.8 grains, or the one thousandth of a kilogramme.

Analysis of the same Ore. By Mons. Berthier.*

Oxide of iron, - - -	0.626
Water and carbonic acid, -	0.170
Silex, - - - -	0.032
Oxide of zinc, - -	0.172
	1.000

Analysis of the Argillaceous Carbonate of Iron of the Coal Measures (fer Carbonatè Argileux de Houilleries,) of Dour, (Mons.) By Berthier.

10 grammes of crude ore = of calcined ore,	7.60
Added as flux, 3.60 of lime stone = of quick lime,	2.03
Total,	9.63
And we obtained of pig iron, 2.37, of scoria, 6.20, =	8.57
Loss in volatile matter,	1.06

Flux, - - - - - -	2.03
Vitreous matter of the ore, - -	4.17
Insoluble, " - - - -	3.60
Soluble, " - - -	0.57

The metal was grayish, and good for rolled iron. The slag was vitreous, transparent, and of a deep gray colour.

Analysis of the Limonite of Bayon, (Liege,) made at the Laboratory of the School of Mines. By M. Delvaux.

This mineral is of a dark brown colour, hard, and compact. It loses, by calcination, 0.19 of water and carbonic acid, and when treated with hydro-chloric acid, leaves a residuum of silex = 0.032. Weak nitric acid dissolves 0.181 of carbonate of lime, and 0.024 of carbonate of zinc.

10 grammes of crude ore = of calcined ore,	8.10
There was added, as a flux, Silex,	1.55
Clay,	1.00
Lime stone, 2.50 = of lime,	1.41
Total of fixed matter,	12.06

* It was from this ore the best gun metal was formerly obtained for the Royal Cannon Foundry; but it is all used, at present, at Seraigne.

Amount forward,			12.06
There was obtained,	metal,	3.65 (of iron,)	
	slag,	5.32 =	8.97
	Loss,		3.09
The flux added,		3.96	
Insoluble matter,		0.32	
Soluble "		1.04	

There remained, of the vitreous matter of the ore, 1.36.
The metal obtained was gray, and malleable.

Analysis of a Specimen of Pig Iron, (fonte,) from Charleroi. By Berthier.

This iron was prepared with coke, is of a *deep*, or *dark* gray colour, without being black; is very soft, and makes the best castings for machinery of any iron of the continent.

Carbon, - - - - -	0.023
Silex, - - - - -	0.035
Iron, - - - - -	0.942
	1.000

Ores of Zinc. By Berthier.

Anhydrous carbonate of zinc, from Ampsin, near Huy.

Oxide of zinc,	0.574	0.890 carbonate of zinc,	
" iron,	0.040	0.065 " " iron,	
" manganese,	a trace	0.042 gangue,	
Water and carb. acid,	0.341		
Earthy gangue,	0.042	0.997	
Total,	0.997		

Calamine from "Old Mountain," between Liege and Aix la Chapelle.

	No. 1.	No. 2.
Oxide of zinc,	0.632	0.054
Silex, - -	0.256	0.020
Water, - -	0.010	0.006
Carbonate of zinc,		0.890
Oxide of iron, -	0.048	0.030
Alumina, -	0.034	
	0.980	1.000

No. 1. Anhydrous calamine.

No. 2. The ordinary yellow amorphous ore of zinc. It is a mixture of the anhydrous carbonates, and the hydrated silicates of zinc. This mineral, when calcined and decomposed, is found to consist of the following constituents.

Oxide of iron, - - - -	0.083
" zinc, - - -	0.647
Carbonic acid and water, - -	0.072
Alumina and silex, - - -	0.195
	0.997

The extraordinary abundance of the mineral resources of Belgium, including fuel, has given rise to the establishment of numerous works for the manufactory of castings, of rolled iron, of steel, of sheet iron, of copper, and of tin. This branch of industry may be considered as divided into three principal groups. *First*, the River group, (that of the Meuse, from its entrance into Belgium to the limits of the Provinces of Namur and Liege.) *Second*, the group between the Sambre and Meuse, (including the furnace of Couvin,) and *third*, the group of Charleroi, (to which are attached the furnaces of Clobecq, near Tubin.) Beside these groups, we must observe that on the Floyoux, on the Ourthe, and on the tributaries to this latter river, there are a large number of blast furnaces, forges, rolling mills, and foundries. In 1837, there were in Belgium, twenty-three blast furnaces, worked with coke, and sixty-six with charcoal, in constant use.* There are at present not less than forty-five coke furnaces in operation, and the number is rapidly increasing. A company has recently erected, on the plains of Sclessin, six enormous coke furnaces, in a single stack, of dimensions heretofore unknown on the continent.

It is estimated that the furnaces of this kingdom produce nearly 200,000 tons (of 1000 kilogrammes,) of iron, annually; the French furnaces yielding about 300,000 tons, and the English considerably more than 600,000.

From 1830 to 1836, the mean price of rolled iron was, for the best quality, about $80 per ton, and for the second quality, $60 per ton, the highest price having been paid for the first quality, $90, and the lowest, $75. There is, at present, quite a depression in this branch of production.

Copper ore is found principally in the provinces of Hainaut and

* In France, there are 508 blast furnaces, of which twenty-eight only are worked with coke. It has been ascertained that coke furnaces yield from three to five times more metal than the charcoal furnaces.

Liege; lead in those of Liege, Namur, and Luxemburg, in which is situated the Longilly mine, the most important locality in the country. Zinc is worked at Namur and Hainaut; manganese in Liege; pyrites, calamine, sulphur, and alum, in Namur and Liege.

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the cost of Embankments of Earth, when made with Carts.

By Ellwood Morris, *Civil Engineer.*

Early in his professional career, the writer had frequent occasion to deplore the want of accurate knowledge, regarding *the cost per cubic yard* of embankments of earth; having sought through books *in vain* for correct information upon this point, he endeavoured to supply the defect by application to the experience of elder practitioners, but soon found that even the most experienced Engineers, whom he had the opportunity of consulting, possessed only vague and uncertain information upon this subject; they decided the value of embankment by judgment alone—hence they were frequently mistaken—and none with whom he then conferred, seemed to be acquainted with any rule for the general determination of this question from easily acquired data; this apparent deficiency amongst professional men, concerning a matter of such importance as the value of embankment, entering so largely as it does into the construction of public works, attracted the fixed attention of the writer, and determined him to commence, and upon every convenient occasion to prosecute, a series of experiments with different soils and lengths of hauling, until sufficient data was acquired to enable him to effect a practical solution of *the problem of the value per cubic yard of embankments of earth of any given average haul.*

The observations necessary for the acquisition of suitable data, were made in the formation of embankments of different soils, in different situations, in various stages of weather, and with mean lengths of haul ranging from 100 to 1800 feet; these preliminaries were completed some years ago, formulæ based upon these were drawn out, and now after having satisfactorily tested their accuracy by actual application, to the ascertained cost of embankments of different soils and average hauling, amounting in the aggregate to *more than one hundred and fifty thousand cubic yards;* the writer conceives that they have been verified by practice, upon a scale sufficiently large to warrant him in offering them to the public, with the assurance that *these formulæ may safely be relied upon in practice.*

Owing to the great diversity observable in the consistency of the natural soils, whence embankments are usually formed, something

must of course be left to the judgment of the Engineer; but it is fortunately practicable, both to rescue from the dominion of conjecture, the chief items of cost, and also to confine the chances of errors within very narrow limits—such is the inherent character of the question solved by our formulæ—how successfully, will appear in the comparisons we shall hereafter adduce, between the carefully ascertained cost of several considerable embankments, and the value per cubic yard, which under the same circumstances, would result by computation from the formulæ.

Vehicle and pace of Transportation.

Unlike the course usually pursued *abroad*, where embankments are generally made by cars, carried out upon a temporary railway, and dumped in a single breast of the full height of the bank; *in this country* embankments are almost invariably *formed in layers, and the materials hauled on in carts drawn by a single horse.*

A one horse cart is assumed to be the vehicle of transportation to the embankments of which our formulæ will determine the cost, and it is *to carted embankments alone* that the present remarks and computations are designed to apply.

A numerous series of experiments repeatedly verified, indicate that the average pace of a horse in carting embankment, is at the rate of *one hundred feet of trip or* 200 *feet lineal per minute;* by *trip* we design to include *both* going out and coming back, the outward pace with the load being a little slower, and the inward rather faster, so as to establish as *a mean result* the progress stated above.

Classes of Earth, and days' work of Men loading each.

For practical uses it will be sufficient to divide common earth into *three classes*, varying in their consistency and somewhat in their density, though such a classification must necessarily be arbitrary, as it is utterly impossible so to classify earthy materials, as to meet and cover *exactly* every practicable case.

1st class.—*Gravelly Earth.*—This includes all such materials as gravel, or gravel and clay mixed, and in fact all the heaviest and firmest earths.

Satisfactory experiments have established the fact, that of the material we call *gravelly earth*, a medium laborer will load into a cart in ten working hours, *ten cubic yards measured in bank.*

2nd class.—*Loam.*—This includes those earths so generally found, which consist mainly of sand and clay mixed.

Of this material, experiments indicate, that a medium laborer will, within ten hours work, load into a cart, *twelve cubic yards measured in bank.*

3rd class.—*Sandy Earth.*—This includes the marly earths, along with those in which sand predominates; this material is usually light, loose, and easily handled.

Experiments have proved, that of this species of material a medium laborer in ten hours of work, will load into a cart, *fourteen cubic yards measured in bank.*

To load, of the several classes of earth respectively, material equivalent to 10, 12, and 14 cubic yards *measured in bank*, requires the lifting of about $\frac{1}{9}$ more if *measured in excavation*, and this is owing to the well known *compression of earth when placed in bank*, a subject we do not propose to discuss in this connexion, as it does not seem indispensably necessary to the present purpose.

Species of haul, and cartload in each.

As we have made a practical division of earthy materials, into three species, so also will we classify the hauling in its application, to average weather, and such embankment roads as are commonly used upon well managed works, and in deciding to which class any particular case of hauling belongs, *the general features of the road and the probable draft thereon*, must be carefully considered, as no exact and universal rule can be established.

1. *Descending hauling.*—In this species carts usually carry $\frac{1}{3}$ of a cubic yard *measured in bank.*

2. *Level hauling*—In this species carts generally average $\frac{10}{27}$ of a cubic yard *measured in bank.*

3. *Ascending hauling*—In this species carts generally carry $\frac{1}{4}$ of a cubic yard *measured in bank.*

Loosening the material.

Shovels with short handles are usually employed in loading earth for embankments, but before the shovellers can operate, it is generally necessary to *loosen the material* either by *the pick or plough*, though the lighter soils of the third class (*sandy earth*) may frequently be spaded at once into carts.

Gravelly earth, and the stiffer kinds of clay generally require to be loosened by *the pick.* *Loam* can almost always be *ploughed* by a good team, and *sandy earth*, when it cannot be *spaded*, will always yield to *the plough.*

The expense of *loosening* or preparing the earth to be loaded into carts by the shovellers, will seldom be less than *one*, and not often more than *eight cents* per cubic yard, but this is one of those subordinate items which is variable in its nature, and must necessarily be left to be fixed by the judgment of the Engineer, upon view of the

material, the cost of forming which into an embankment of *a given mean haul*, he desires to know.

In *loam* the writer found, by a number of experiments, that a three horse plough would loosen for the shovellers, from 250 to 800 cubic yards per day, which, when the plough and drivers cost $5 per day, would cause the value of *loosening* to vary from two cents to six mills per yard; hence it is evident that an error in estimating the value of loosening, will not very essentially affect the results produced by our formulæ, because this item is but *a small part of the whole cost* of a cubic yard of bank.

Notation and Data.

Constant quantities ascertained by carefully verified experiments.

1. Number of feet of *trip* traveled by each cart per minute = 100 feet, or 200 feet lineal actually moved over.

2. Number of cubic yards of earth *measured in bank* which can be loaded per day of ten hours working time, by a medium laborer, viz:

Of *gravelly earth* = 10 cubic yards.
Of *loam* " = 12 " "
Of *sandy* " = 14 " "

3. *Time lost* in loading, dumping, waiting to load, and all other lost time, per load = 4 minutes.

4. Number of cart loads to the cubic yard of bank.

In *descending hauling* = 3
In *level hauling* = 3½
In *ascending hauling* = 4

5. Cost of trimming and bossing, at a general mean ascertained to be about *one cent* per cubic yard.

Variable quantities, some of which depend upon the prices of labor, and others upon a correct judgment of the circumstances of the case.

a = *average haul* of the embankment, in stations of 100 feet each; thus calling 1245 feet 12 $\frac{45}{100}$ stations.

b = *number of hours actually wrought* per day, which will average through the year about ten hours working time per day.

c = *daily wages of one laborer*, including all allowances, in cents.

d = *daily wages of one cart*, including driver and all other expenses, in cents.

e = *cost of loosening the material* in cents per cubic yard.

The above or the variable quantities, can generally be determined in every case with sufficient accuracy.

Unknown quantities, which will be determined by the solution of the several formulæ.

x = number of cubic yards measured in bank, which can be hauled *by each cart per day*, to the distance of the given average haul, and there deposited.

y = the cost in cents of *one cubic yard of embankment* of the given average haul; clear of all profit to the contractor or person doing the work.

Formulæ, for finding x, the load in cubic yards hauled per day by each cart.

Representing the number of cartloads to the yard by f, the general formulæ will be,

$$\frac{\left(\frac{60}{\frac{a}{100}+4}\right)b}{f}=x.$$

Now substituting successively in the general formulæ instead of f, its numeral values in the several species of hauling (3, $3\frac{1}{2}$, 4,) and then operating upon the resulting formulæ, according to the laws which govern the mutations of algebraic fractions, we derive the following equations:

For *Descending hauling*, $\frac{20\ b}{a+4}=x.$ . . (I.)

For *Level hauling*, $\frac{17\frac{1}{7}\ b}{a+4}=x.$ . . (II.)

For *Ascending hauling*, $\frac{15\ b}{a+4}=x.$ . . (III.)

Formulæ for finding y, the net cost per cubic yard of embankment of earth.

Denoting the number of cubic yards of each class of earth, which can be loaded by a medium laborer in a day of ten hours working time, as heretofore stated, by the symbol g, and putting one cent, for the cost of trimming and bossing per cubic yard; the general formula will be,

$$\frac{c}{g}+\frac{d}{x}+e+1=y.$$

On substituting successively for g its numeral values (10, 12, 14,) in the several different classes of earth, we have,

1st class—*Gravelly earth*, $\frac{c}{10}+\frac{d}{x}+e+1=y,$. (IV.)

2nd class—*Loam*, $\frac{c}{12}+\frac{d}{x}+e+1=y,$. (V.)

3rd class—*Sandy earth*, $\frac{c}{14}+\frac{d}{x}+e+1=y,$. (VI.)

Formulæ, for finding the cost per cubic yard of Embankments of Earth, verified by practice.

The chief part of the cases we are about to cite, as proving the accuracy of our equations of cost, in all which the actual expense of some considerable embankments became known to the writer in a mode that precluded the possibility of mistake, is derived from actual practice upon the Chesapeake and Ohio Canal.

EXAMPLE 1.

Amount of embankment = 28,100 cubic yards.
Material of earth of the second class, *loam.*
Level hauling, an average of 6½ stations, or 650 feet, . = a
Loosening by the plough alone, 1⅔ cents per cubic yard, . . = e
Hours wrought per day = 10 . . . . . = b
Laborers' wages per day at an average of 106 cents, . . = c
Carts' wages " " " 157 cents, . . = d
Bossing and trimming per cubic yard = 1 cent.

Actual cost of the 28,100 cubic yards of embankment, clear of bossing and trimming = $5363.

		cents.
Cost per cubic yard = $\frac{\$5363}{28{,}100}$	=	$19_{\frac{1}{10}}$
Add for bossing and trimming, ...	=	1
Total cost per cubic yard, ...	=	$20_{\frac{1}{10}}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\frac{17\frac{1}{7}\,b}{a+4} = x$ substituting for a and b their numeral values,

we have $\frac{17\frac{1}{7} \times 10}{6\frac{1}{2}+4} = \frac{\frac{1{,}200}{7}}{10.5} = \frac{1{,}200}{73.5} = 16_{\frac{3}{10}}$ cubic yards $= x$.

2nd. By Formula (V.) to find y, the cost per cubic yard in bank.

(V.) $\frac{c}{12} + \frac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have $\frac{106}{12} + \frac{157}{16.3} + 1.67 + 1 = 21_{\frac{1}{10}}$ cents $= y$, the cost per yard.

Difference between the real and calculated cost = 1 cent per yard.

EXAMPLE 2.

Amount of Embankment = 42,140 cubic yards.
Material of Earth of the third class; *sandy earth.*

Level hauling, an average of 9 stations, or 900 feet, . . . = a
Loosening by plough and spade = 1 cent per cubic yard, . . = e
Hours wrought per day = 10, ... = b
Laborers' wages per day at an average = 110 cents, . = c
Carts' wages " " " = 160 cents, . . = d
Bossing and trimming = 1 cent per cubic yard.

Actual cost of the 42,140 cubic yards clear of bossing and trimming = $8,775.

Cost per cubic yard, $= \frac{\$8{,}775}{42{,}140}$	=	cents. $20\frac{8}{10}$
Add trimming and bossing, ...	=	1
Total cost per cubic yard, ...	=	$21\frac{8}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\frac{17\frac{1}{7}\,b}{a+4} = x$. Substituting for a and b their numeral values, we have, $\frac{17\frac{1}{7} \times 10}{9+4} = \frac{\frac{1{,}200}{7}}{13} = \frac{1{,}200}{91} = 13\frac{2}{10}$ cubic yards $= x$.

2nd. By Formula (VI.) to find y, the cost per cubic yard in bank.

(VI.) $\frac{c}{14} + \frac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters, we have, $\frac{110}{14} + \frac{160}{13\frac{2}{10}} + 1 + 1 = 22$ cents $= y$, the cost per yard.

Difference between the real and calculated cost $= \frac{2}{10}$ of a cent per cubic yard.

EXAMPLE 3.

Amount of Embankment = 23,500 cubic yards.
Material of Earth of the third class; ***sandy earth.***
Ascending hauling, an average of 6 stations, or 600 feet, . = a
Loosening by the plough and spade = 1 cent per cubic yard, = e
Hours wrought per day = 10, ... = b
Laborers' wages per day at an average = 120 cents, . . = c
Carts' wages " " " = 165 cents, . . = d
Bossing and trimming = 1 cent per cubic yard.

Actual cost of the 23,500 cubic yards of embankment clear of bossing and trimming = $4,939.

Cost per cubic yard $= \frac{\$4{,}939}{23{,}500}$ . . . . . $=$ cents. 21

Add for bossing and trimming, ... $=$ 1

Total cost per cubic yard, ... $=$ 22

Cost by the Formulæ.

1st. By Formula (III.) to find x, the load hauled per day.

(III.) $\frac{15\ b}{a+4} = x$. Substituting for a and b their numeral values, we have, $\frac{15 \times 10}{6+4} = \frac{150}{10} = 15$ cubic yards $= x$.

2nd. By Formula (VI.) to find y, the cost per cubic yard in bank.

(VI.) $\frac{c}{14} + \frac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have, $\frac{120}{14} + \frac{165}{15} + 1 + 1 = 21\frac{6}{10}$ cents $= y$, the cost per cubic yard.

Difference between the real and calculated cost $\frac{4}{10}$ of a cent per cubic yard.

EXAMPLE 4.

Amount of Embankment $=$ 36,000 cubic yards.

Material of Earth of third class; *sandy earth.*

Level hauling, an average of $9\frac{2}{10}$ stations, or 920 feet, . . $= a$

Loosening by plough and spade $=$ 1 cent per cubic yard, . $= e$

Hours wrought per day $=$ 10, ... $= b$

Laborers' wages per day at an average $=$ 118 cents, . $= c$

Carts' wages " " " $= 162\frac{1}{2}$ cents, . . $= d$

Bossing and trimming $=$ 1 cent per cubic yard.

Actual cost of the 36,000 cubic yards of bank, including bossing, &c., $=$ \$8,149.

Cost per cubic yard, $= \frac{\$8{,}149}{36{,}000}$ . . . . . $=$ cents. $22\frac{6}{10}$

Bossing, &c., ... 0

Total cost per cubic yard, ... $= 22\frac{6}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\frac{17\frac{1}{7}\ b}{a+4} = x$. Substituting for a and b their numeral values,

we have, $\frac{17\frac{1}{7} \times 10}{9\frac{3}{10} + 4} = \frac{\frac{1,200}{7}}{13\frac{3}{10}} + \frac{1,200}{92\frac{4}{10}} = 13$ cubic yards $= x$.

2nd. By Formula (VI.) to find y, the cost per cubic yard in bank.

(VI.) $\frac{c}{14} + \frac{d}{x} + e + 1 = y$. Substituting the numeral values for the letters,

we have, $\frac{118}{14} + \frac{162\frac{1}{2}}{13} + 1 + 1 = 22\frac{5}{10}$ cents $= y$, the cost per cubic yard.

Difference between the real and calculated cost $\frac{3}{10}$ of a cent per cubic yard.

EXAMPLE 5.

Amount of Embankment = 22,075 cubic yards.
Material of Earth of the second class; *loam.*
Level hauling an average of 10 stations or, 1000 feet, . . = a
Loosening by heavy ploughs = $2\frac{1}{2}$ cents per cubic yard . . = e
Hours wrought per day = 10. . . . . = b
Laborers' wages per day at an average = 125 cents, . . = c
Carts' wages " " " = 175 cents, . . = d
Bossing and trimming = 1 cent per cubic yard.
Actual cost of the 22,075 cubic yards of embankment, including bossing, &c., = $6,166.

Cost per cubic yard $= \frac{\$6,166}{22,075}$	=	cents. $27\frac{9}{10}$
Bossing, &c., ...	=	0
Total cost per cubic yard, ...		$27\frac{9}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\frac{17\frac{1}{7}\, b}{a + 4} = x$. Substituting for a and b their numeral values,

we have, $\frac{17\frac{1}{7} \times 10}{10 + 4} = \frac{\frac{120}{7} \times 10}{14} = \frac{1,200}{98} = 12\frac{3}{10}$ cub. yds. $= x$.

2nd. By Formula (V.) to find y, the cost per cubic yard in bank.

(V.) $\frac{c}{12} + \frac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have, $\frac{125}{12} + \frac{175}{12\frac{3}{10}} + 2\frac{1}{2} + 1 = 28\frac{1}{10}$ cents $= y$, the cost per cubic yard.

Difference between the real and calculated cost $= \frac{2}{10}$ of a cent per cubic yard.

Recapitulation of the comparisons between the real and calculated cost per cubic yard of Embankments of Earth containing in the aggregate 151,815 *cubic yards.*

No. of experiments.	Number of cubic yards in the bank.	Average haul in stations of 100 feet each.	Kind of hauling.	Class of the earth.	Actual cost per cubic yard in cents.	Cost calculated by the Formulæ in cents.	Difference per cubic yard in cents.
1	28,100	$6\frac{1}{2}$	level	loam	$20\frac{1}{10}$	$21\frac{1}{10}$	1
2	42,140	9	level	sandy earth	$21\frac{8}{10}$	22	$\frac{2}{10}$
3	23,500	6	ascending	sandy earth	22	$21\frac{6}{10}$	$\frac{4}{10}$
4	36,000	$9\frac{3}{10}$	level	sandy earth	$22\frac{6}{10}$	$22\frac{9}{10}$	$\frac{3}{10}$
5	22,075	10	level	loam	$27\frac{9}{10}$	$28\frac{1}{10}$	$\frac{2}{10}$

An examination of the above table shows that the differences between the *real and calculated cost* per cubic yard, of the several quantities which, when aggregated, form the full amount of 151,815 cubic yards of bank, did in no case exceed *one cent per cubic yard.*

Other tests upon smaller individual amounts having verified the embankment equations with equal precision, the writer hazards nothing in expressing his conviction that the formulæ above given, *will, as general rules, be found trustworthy.*

The formulæ apply equally well to every species of hauling in single carts, by making such slight alterations as would be due to the difference, between the specific gravity of common earth and of the other material proposed to be hauled; thus if the equations are properly transformed, the application of the rules to embankment of rock, hauled in one horse carts is both simple and easy.

Here our remarks naturally terminate, and further the mathematical reader need not progress; but although the foregoing equations of cost, are expressed in the simplest algebraic forms, still as there may be some amongst our readers who are not much used to the symbols of algebra; we will, even at the risk of prolixity and repetition, enunciate them in words at length for the benefit of such persons; the Roman

numerals indicate in the several rules those formulæ which are turned into common language.

To find the load in cubic yards hauled per day by each cart.

I. In Descending Hauling.

Multiply the number of hours wrought per day by the number 20, then divide the product by the number of stations (of 100 feet each) contained in the average haul, added to the constant number 4, and the quotient will be the number of cubic yards which one cart can haul the given distance in a day.

II. In Level Hauling.

Same as rule I, except that the first multiplier must be $17\frac{1}{7}$ instead of 20.

III. In Ascending Hauling.

Same as rule I, except that the first multiplier must be 15 instead of 20.

Having by one of *the rules* above, found the number of cubic yards which a cart can haul in a day of 10 hours' work, upon the kind of road referred to, then by one of *the rules following*, the cost of the embankment per cubic yard may be found, if the class of the earth whence it is formed be known.

To find the cost in cents per cubic yard of Embankment of Earth.

IV. Bank formed of Gravelly Earth.

Divide the daily wages in cents of one laborer by the number 10, add the quotient to that of the daily wages of one cart in cents, divided by the number of cubic yards hauled per day per cart, as found by former rules, and to the sum of these two quotients, add successively the estimated cost in cents per yard, of loosening the material, and one cent for bossing and trimming, the sum of all will be the cost of one cubic yard of the embankment.

V. Bank formed of Loam.

Same as rule IV, except that the first divisor must be 12 instead of 10.

VI. Bank formed of Sandy Earth.

Same as rule IV, except that the first divisor must be 14 instead of 10.

Of course in using any of these rules the average length and kind of haul, the wages, &c., must be previously known as in the several examples adduced.

Philadelphia, July 19th, 1841.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Colonel Long's *Bridges.*

In a former number of this Journal, (see vol. xxiv, pp. 325 to 333,) are exhibited specifications and drawings explanatory of certain improvements in bridge building, under the designations of the brace bridge, and the suspension bridge, patented by Col. Long, on the 7th of November, 1839. In the present number, we take occasion to lay before our readers additional drawings of the same methods of construction, in one of which is presented a side view of an entire truss-frame of the brace bridge, and in the other a similar view of an entire truss-frame of the suspension bridge. (See the drawings on plate II.)

In the figures relating to both methods, the inferior arch braces, with their appropriate gibs, keys, and other fastenings, are represented, rising from their appropriate bearings at the abutment and pier, and connecting with the lower strings, at points suitable for their reception. In the side view of the brace bridge, the appropriate positions of the side arch braces with their sills at the lower, and plates at the upper strings, are represented by dotted lines. On each side of the truss-frame, a sill may be applied at each abutment and pier, in contact with the lower string, and extending through one or more panels, at the discretion of the builder; and in like manner, a plate may be applied midway of each span, in contact with the upper string, and extending through one, or more, panels, from the centre of the span. From the sills, one, or more, arch braces in each half span, may rise and pass diagonally across one, or more, panels, in a direction towards the centre of the span, being extended far enough to reach the plates, with which, as also with the sills, the brace timbers should be connected by means of appropriate notches, tuscums, &c. The side arch braces, sills, and plates, at their junction, should be connected to the truss-frames by screw bolts, and iron plates or washers, the bolts passing entirely through the truss-frame. Screw bolts, in like manner, should be applied at every intersection of the posts by side arch braces. The fastenings at all other points should consist of tree-nails, which should be inserted in such positions, and with such frequency, as to ensure the requisite action and efficiency in those useful parts of the structure.

The arrangement here contemplated, differs very considerably from that provided for, agreeably to the specifications before cited. Its advantages consist in the greater facility and economy with which the inferior and side arch braces may be applied to a truss-frame, and in the greater frequency with which these useful and important parts of the structure may, with convenience, be applied.

S. H. L.

Notices of Railways in Germany.

From the London Railway Magazine.

Although the first railroad in Germany intended for the transportation of passengers and goods, that from Budweis to Lintz, had been undertaken already in 1824, it was not until the last five years that this line of internal communication has been somewhat generally introduced in this part of the European continent. But in this short period a great deal has already been accomplished, and after a few years more, Germany will boast of a railway system by which its principal and important cities will be connected. A description of the different railways already completed, or in course of construction, made from authentic data collected on the spot, will perhaps be of some interest to the readers of the Railway Magazine, not only because England is so much interested in those works, for which it furnishes the iron, machinery, &c., and sometimes even the engineers, but also by making the English traveller acquainted with the means of internal communication of which he can avail himself, on his tours through the continent. In the following series of articles on the above subject the different railways are described in the order they have been examined, and no regard is paid as to which has been first executed.

The Taunus Railway.—(From Frankfort-on-the-Main to Mentz and the Wiesbaden.)

This railway derives its name from the Taunus Mountains, along which it extends; it connects the commercial city of Frankfort-on-the Main, with the steam navigation on the Rhine, the important city and fortress of Mentz, and the much frequented watering place of Wiesbaden, and passes through the territories of the free city of Frankfort, of Hesse Darmstadt and of Nassau. The Company for the construction of this railway was formed in 1836, and the capital of three millions of florins (or £250,000 sterling) subscribed; owing to the high value of the lands in this section of country, and the circumstance of the railway being located through three different territories, great difficulties were experienced in the procuration of the right of way, which, at the same time, has cost the Company an enormous sum. The construction of the railway was commenced in 1837; in September, 1839, the section between Frankfort and Hochst, of five miles, was opened for public use, and in April, 1840, the whole line from Frankfort to Mentz and Wiesbaden.

The principal object of the Taunus railway is the conveyance of passengers between the above mentioned places, and from its favourable position, it will always command a passenger traffic, and may be classed amongst the important and profitable lines of internal improvement in Germany. Frankfort, with a population of 50,000, is the centre of a considerable intercourse; there are constantly from 10 to 20,000 strangers in the city, coming from, and continuing their journey to, every part of the continent. Mentz contains 36,000 inhabitants, besides a garrison of 20,000 men; and the population of Wiesbaden is 12,000. The river Main, on which Frankfort is situated, and which empties itself into the Rhine at Mentz, is not navigable

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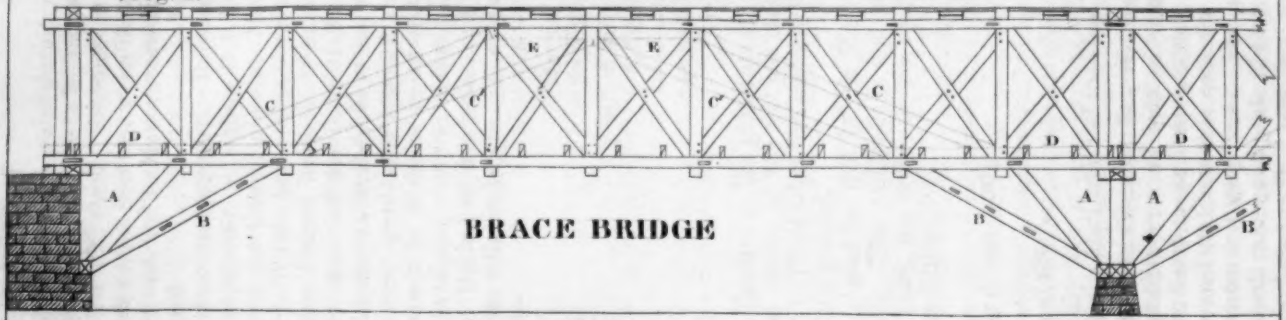
COL. LONG'S BRIDGES.

Fig. 1.



BRACE BRIDGE

Fig. 2.

SUSPENSION BRIDGE

for steamboats, owing to the shallowness of its water during summer. At Mentz the steamboats from the upper and lower Rhine meet, and the railway trains run in connexion with them. Still more important and prosperous the Taunus railway must become, when its projected continuation to Heidelberg on the one, and to Hanover and Hamburg on the other side, shall be executed.

The railway traverses a very interesting country. In passing over it, the Taunus Mountains are constantly in sight. It follows the course of the river Main to Cassel (or Castel) opposite Mentz, and then turns off to the right towards Wiesbaden. About midway between the latter two places a short branch leads off from the main line to Biebrick, the beautiful residence of the Duke of Nassau, on the river Rhine. There are many curves in the line of the railway, which, however, are generally very gentle, the smallest radius of curvature is 2,300 feet. The branch to Biebrick is connected with the main line by two short curves of only 328 feet radius. There is a straight line from Frankfort to Hochst, of five miles, and another from Hochst to Florsheim, of seven miles in length. The total length of the railway is as follows, viz:—

	Metres.	Miles.
From Frankfort to Cassel, - - -	33,329	or 20.70
From Cassel to Wiesbaden, - - -	8,620	5.35
Branch railway to Biebrick, - - -	1,434	0.89
	43,383	26.94

or very near twenty-seven miles.

There are, in the whole, forty changes in the gradients of the railway, which vary from level to an ascent of 28½ feet per mile. The railway descends from Frankfort to Wiesbaden, but undulates to conform with the natural surface of the ground.

The construction of this road resembles that of the English railways, of which it is an imitation. The excavations and embankments were made for a double track, the width of the road bed is twenty-four feet, and is divided as follows:

	Ft.	In.
From centre of road bed to centre of inner rail, - -	3	
From centre to centre of rail, - - - -	4	11
From centre of outer rail to edge of slope, - -	4	1
Half width of road bed	12	feet.

The clear width of the track is, as in England, four feet eight and a half inches; the bridges and culverts were all built of stone, with the exception of two over the fortifications at Cassel, which have a wooden superstructure. The longest bridge is that over the Nidda, which has three arches of thirty-three feet span each. The embankments, erected principally from earth taken alongside of the railway, are generally very low, the highest being twenty-nine feet; the deepest cutting is only thirteen feet. At an average, the Company has paid 2d. per cubic yard of earth excavation, and 9s. per cubic yard

of masonry. The wages of a common labourer were, at the time of the construction of the railway, from 10d. to 1s. per day; those of a mason, or carpenter, 1s. 6d.

The superstructure is made in the following manner:—upon the surface of the road bed is a layer of broken stone, or gravel, ten feet wide for each track, upon which are put stone blocks, where the railway is in cutting, or even with the natural surface of the ground, and cross wooden sleepers on embankments. The stone blocks are of red sand stone, brought from Ashaffenburg, in Bavaria, about forty miles from Frankfort, and measure twenty-six inches square by thirteen deep. Their sides parallel to the line of rails, five under each rail, (of 15½ feet in length,) but so that those nearest to the joints of the rails are two feet ten inches from centre to centre, and those under the middle of rail, three feet three and a half inches. The wooden sleepers are of oak timber, half round and flattened on the top only, where the chairs rest, eight and a half feet in length, and seven inches high; they were put at the same distance from each other as the stone blocks. The price of a sleeper, delivered to the railway, was 4s. 6d., that of a stone block, 4s. 3d., or nearly the same. The iron rails are of a pattern similar to that on the London and Birmingham railway, weighing fifty-two pounds per yard, rest in chairs fastened upon every block, or sleeper, and are kept fast in the same by wooden filling pieces driven in outside the track. The chairs at the joints of two rails weigh twenty-four pounds, the intermediate ones, twenty pounds. A piece of felt is laid between the stone block and the cast iron chair, to diminish the bad effect occasioned by the roughness of the former. The space between the stone blocks, or sleepers, was filled out with broken stone, or gravel, up to the lower edge of the rail, and to a width of five feet on each side from the centre of the track. The remainder of the space between the gravel bed and the slope was filled up with earth to the same height as the gravel, with a fall of five inches to the slope. At intervals, from fifteen to thirty feet small channels were made in the banquette, and filled with gravel, in order to drain the foundation.

The Company has erected very spacious station buildings at Frankfort, Cassel, and Wiesbaden; shops for the repairing of locomotives, and carriages, are at Frankfort. Intermediate stations, where passengers are taken and left, are at Hochst, Hattersheim, Florsheim, and Hochheim. Water is always taken in at Hattersheim, and serves for two half trips.

There are at present, on the railway, six locomotive engines, from the manufactory of Robert Stephenson & Co., Newcastle-upon-Tyne; they have twelve (some thirteen,) inch cylinders, eighteen inch stroke, and six feet driving wheels; 100 passenger carriages of four different classes; the first and second class carriages are closed, and contain each eighteen seats, in three departments; the third and fourth class carriages are open on the sides, and have room for thirty to forty passengers. The carriages were manufactured partly in Hochst, and partly in Frankfort; the price of a second class carriage is £170, that of a third class one, £125.

Of the capital stock of the Company, (£250,000 sterling,) about £180,000 have been expended for the railway, buildings, fixtures, and material, which is at the rate of £6,667 sterling per mile. The chief engineer of this railway was Mr. Denis, who has also constructed the Nuremberg and Furth railway.

The Taunus railway has hitherto been used only for the transportation of passengers, and no arrangements have as yet been made for carrying also merchandize, &c. Since the road has been partly opened, in September, 1839, up to the 1st of July, 1840, the total number of passengers conveyed over the railway was 281,510, and the income £10,000 sterling. From April to July, during which period the whole line was in operation, the number of passengers has been 180,000.

There are daily five trips made between Frankfort and Cassel, and seven between Cassel and Wiesbaden, and the fares are, for a seat from Frankfort:—

	To Mentz.		To Wiesbaden.	
	s.	d.	s.	d.
In 1st class carriage, - -	3	6	4	6
2nd class " - -	2	5	3	0
3rd class " - - -	1	8	2	1
4th class " - -	1	2	1	5

The fare for way passengers is the same in proportion to the distance. From the above, it appears that the charge per passenger per mile, is:

In 1st class carriages, - - - -	2.08d.
2nd class " - - - -	1.38d.
3rd class " - - - -	0.96d.
4th class " - - - -	0.65d.

Each passenger is allowed forty pounds of baggage; for every pound exceeding this quantity he is charged at the rate of about 0.4d. per lb., or 3s. 4d. per 100 lbs. for the whole distance from Frankfort to Wiesbaden. The charges for over-weight of baggage are, therefore, as high as for the same weight of passengers in carriages of the first class!

In the whole management of the railway a great want of ability and experience is every where visible; which, however, must be attributed in part to the circumstance that the work is yet quite new, and the first established in this part of Germany, and that the individuals employed (of which there are rather too many,) are yet inexperienced in their new business. Although the station at Frankfort is only a quarter of an hour's walk from the centre of the city, the omnibus calls at the different hotels generally three quarters of an hour before the time of the departure of the trains. On arriving at the station, passengers procure their tickets at the office windows, and on presenting the same are admitted into a large room, where they have to wait in a crowd, until ten minutes before the time of starting. At the ringing of the first bell the door is opened, when they may walk over a large yard to the hall, (so called,) under which the carriages are arranged. Five minutes after, the second bell rings, which denotes that no more tickets are to be sold, and at the sign of the third and last bell the train departs.

At an average, there are from twelve to fourteen carriages in a train; with this load the engines travel at the rate of twenty miles per hour. The engine-men regard fourteen carriages as a full load for the locomotives, if they have to travel at that speed. The fuel used is coke, made from coal on the Rhine; the quantity used for a trip between Frankfort and Wiesbaden, twenty-three miles, is 1200 pounds, and the price is 2s. per 100 pounds, delivered to the railway. The expense for fuel is, therefore, per mile of travel, nearly 1s.

Sixty men are constantly stationed on the line, for the purpose both of watching and repairing the railway; they receive £1 10s. per month, and are divided in several parties, over each of which a superintendent is appointed. For the trips, the Company employed six engine-men, and two superintendents in the repairing shops. Ten conductors are employed to accompany the trains.

The branch railway to Biebrick has only been lately opened, and is used with horse power. Passengers coming up the Rhine by steamboats, and having the intention to visit Wiesbaden, may leave the Rhine at Biebrick, or continue their journey to Mentz, from both places a few miles travel over the railway will bring them to the celebrated watering place. A long floating bridge over the Rhine connects the city of Mentz with Cassel and the railway.

[TO BE CONTINUED.]

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. BOUCHERIE, M. D.

[CONTINUED FROM PAGE 99.]

I have no where found any traces of a serious study of the causes which produce alteration in wood. It has indeed been said, in a general way, that wood is rotted, either because moisture and heat united, set it in fermentation, or because worms are introduced into the substance, where they are spontaneously developed and indefinitely multiplied. But to my knowledge, no one has examined whether the different elements of wood contribute equally to this fermentation and generation of worms, or whether some peculiar and perfectly distinct parts of its tissue are alone the cause of it.

I have applied myself to obtain by experiment some definite fact in reference to this, and my observations have resulted in this simple, but important principle; *that all the alterations which wood presents are due to the soluble matters which it contains.* They alone, in contact with a certain quantity of water, the action of which is aided by a proper temperature, have the power of becoming heated, decomposing and furnishing a corrosive liquid which penetrates the woody fibre, alters its structure, destroys its resistance, and transforms it into a substance, which, by final analysis, presents many of the characters of ulmic acid.

It is these soluble matters alone, which possess nutritive properties, and which aid the development of those numerous and varied animals which sometimes devour even the most compact woods.

The facts upon which this proposition is grounded, have been observed more particularly in oak. This wood, containing a large quantity of soluble matters, and producing strongly marked re-actions with the salts of iron, appeared to me likely to present the most appreciable differences, and to permit the most rapid experiments. My predictions have been realized, and I here give the results which I have obtained.

1. Oak wood, completely rotted, contains scarcely any soluble matters, and the proportion of these substances always follows the degree of alteration of the wood. The confirmation of this fact was obtained by means of washing saw-dust, of timber altered in different degrees. The waters used were concentrated, after mixing with a known weight of sand, which allowed them to be dried, without decomposition; and the weight of the soluble matters was determined by weighing the whole mass, from which weight that of the sand was subtracted.

The saw-dust from good wood gave me from five to six per cent. of soluble matter; that which was altered, gave less and less, descending to one per cent., and even to a fraction of one per cent. when the rot was general, and well advanced. In many of my experiments I confined myself to judging of the alteration of the wood, by the more or less energetic action which it presented, in contact with salts of iron. I traced upon a suspected piece, a line with a solution of a salt of iron, and the intensity of the colouring, indicated with sufficient exactness, in rotted wood, what was the degree of their decay. Some pieces, entirely decomposed, gave not a trace of tannin. I will mention, upon this occasion, that the study of the alteration of certain woods, conducted in this way, permits us to make some interesting remarks. I have thus recognized altered points disseminated in the midst of healthy parts, and long lines of decay placed between other lines which remained in their natural state. Such facts raise a doubt as to the homogeneousness of the tissue of wood.

2nd. If we take equal quantities of washed and unwashed saw-dust, equally dry, and moisten them with equal quantities of water, taking care to compensate equally in each case for the loss by evaporation, it always happens that after a certain number of days, that which was unwashed, becomes covered with a thick mould, while after six months, the washed saw-dust presents no indication of the kind. Examining their weight, after this lapse of time, we shall find that that of the washed saw-dust has remained the same, while that of the other has greatly diminished. I have not determined whether gases are disengaged during the process of alteration, but every thing leads me to believe, that by a proper arrangement of the experiment, I should have been able to detect the disengagement of gases, and determine the nature of them. I shall hereafter examine this fact, in every aspect of interest which it may present.

3rd. Finally, when we follow attentively, in the various channels which they bore in the wood, those large worms which destroy it so rapidly, we quickly perceive that they advance only by powdering the woody substance which they find before them, swallowing it, and

then discharging it either in the state of an impalpable powder, or in masses in which vestiges of fibrous organization are still found. The wood, before being traversed by this animal, yielded to water seven per cent. of soluble matter; after, it yielded a much smaller quantity, rarely amounting to two per cent.

I do not think it proper to swell the list of these facts with those I obtained from the examination of fruits and green stems. The conclusion to which I came, was, that since the soluble substances in wood, are the causes of the alterations which it undergoes, it is necessary, in order to preserve it, either to remove these soluble matters by some means, or to render them insoluble by introducing substances which will thus deprive them of their fermentable and nutritious qualities.

The removal of the soluble substances could only be effected by a species of washing, and although I judged it, a priori, to be impracticable, yet I desired to study the interesting facts which might be presented by experiments upon it, and to prove, by actual observation, the inefficacy of the process.

The following are the results of numerous experiments, into the detail of which it is not worth while to enter.

1st. That the penetration of wood, when plunged into water, is extremely slow, and that, for instance, pieces of oak three feet in length, and nine inches in diameter, continued to increase in weight after ten months maceration. Duhamel proved, a long time since, that parallelopipeds of two inches in height, by one inch square, did not become stationary in weight until after six months immersion.

2nd. That submerged wood discharged very slowly a portion of the soluble substances which it contained, and that this loss was sustained only by the exterior layers, even after a very prolonged submersion.

Having thus satisfied myself that the removal of alterable substances was not practicable, my next task was to seek the means of transforming them into insoluble bodies, in the tissue of the wood itself.

In order to arrive at a solution of this problem, I examined, in the first place, the re-actions which the soluble matters underwent by the action of various chemical re-agents, and when I had assured myself that all salts with an insoluble metallic base precipitated them abundantly, I sought for that, the two components of which should present the greatest advantages under the double aspect of preservative action and cheapness.

The impure pyrolignite of iron appeared to me to unite all the conditions desired.

1st. It is cheap.

2nd. Its oxide forms stable combinations with almost all organic matters.

3rd. Its acid has no corrosive properties, and is volatile.

4th. It contains the greatest proportion of kreosote which an aqueous liquor can dissolve, and it is not now doubted but that this substance protects, with great power, all organic substances against the alterations to which they are liable.

The facts upon which I rest, in declaring these properties, are of two orders—the first, indirect, have been determined from vegetable substances of a very alterable nature, or from saw-dust; the others from timber itself, and these latter present so strong a confirmation of the preservative qualities of the pyrolignite, that they may be already cited as conclusive and decisive.

I shall record them both.

1st. If we take vegetable substances of a very alterable nature, such as flour, the pulp of beets, or carrots, a melon, &c., (which differ from wood, which they resemble in origin and constitution, only by the greater quantity of soluble matters which they contain,) and after preparing them with the pyrolignite, by simple immersion, we leave them to themselves, alongside of similar substances, not thus prepared, and which, in other respects, are under similar conditions of surface, contact with air and moisture; we shall always remark, that if we have used a sufficient quantity of the pyrolignite, we will succeed perfectly in the preservation of these, while the others will exhibit the ordinary course of alteration. I refer to the first table for the detail of the results obtained from flour, and the pulp of beets, placed in contact with various chemical agents, or left to themselves in their natural state. This table may be used as a measure of the degree of protection exercised by various substances.

The experiments upon the melon are remarkable, and appear to me to give the strongest idea of the protective effect of the pyrolignite against the decomposition, which, in this fruit, is so rapid. In all my experiments I proceeded comparatively; the same melon was cut into two parts, one of which was immediately put upon a plate, and the other immersed in the pyrolignite, withdrawn from it after a few hours, and placed upon another plate alongside of the former. The unprepared parts always present the ordinary alteration—the prepared part had acquired a perfect unalterability; it slowly dried, and finally acquired the hardness of wood.

2nd. In treating wood saw-dust by the pyrolignite of iron in an unconcentrated solution, we observe results similar to those which I have just mentioned. In the oak saw-dust, the presence of tannin causes a very deep black tint to appear, which prolonged washing does not diminish. The oxide of iron forms a solid combination, and the greater part of it is found again in the ashes obtained from burning the saw-dust. Abandoned, when moist, to themselves, without preparation, they would have been rapidly covered with mould; the mixture once effected, they alter no more.

I have not been able to trace the slightest indication of alteration during an experiment which lasted six months.

This double fact, of the black colour, and the decomposition of the salt by organic substances, is much more marked in oak than in the white woods, in all of which, however, it is found, wanting only in intensity.

In reference to the question of economy, I was desirous of determining what quantity of the pyrolignite was absolutely necessary to render insoluble all the alterable elements of wood, and I have satis-

fied myself that one-fiftieth part of the weight of the green wood is more than sufficient to produce this effect. This determination was easily made by isolating these substances, by washing a known weight of saw dust, and estimating the quantity of the pyrolignite which it was necessary to add to it, in order to precipitate, completely, all the soluble substances upon which it could act.

I am convinced that among the numerous substances which constitute the soluble matter of wood, tannin and albumen are not the only ones which are rendered insoluble by the salts of iron, but I cannot as yet designate the others. I have undertaken a long examination of this subject, which has not as yet terminated; they alone constitute a work, the extent of which may be estimated by considering that it was necessary to begin by studying the matters themselves.

The direct facts obtained with the wood itself, are the subjects of experiment at the moment of writing this memoir, and in order to diminish the time of the experiment, I have selected a species of wood, much used, and especially employed for the hoops of barrels, which always rot in a short space of time.

This wood was penetrated by the pyrolignite by means of a process which I shall mention to the Academy directly. A committee was appointed by the prefect of the Gironde, to examine these experiments, and under their eyes, in December 1838, I caused to be placed upon the same casks, prepared hoops, and the best hoops of commerce, in their natural state. These casks were then placed in the dampest parts of the cellars. Already (10th of August,) a deep and complete decay is shown by the hoops in their natural state, while those which were prepared, have not undergone any sensible alteration.

I have the honour to submit to the Academy, the official report of this experiment. If the result is shown to be constant, by the prolongation of the experiment, that the natural wood has been for a long time worm-eaten, while the prepared wood has remained entirely untouched, I hope that we may be allowed to reason from chesnut to other woods, and to conclude, that there is great probability of success in executing important works with wood prepared by impure pyrolignite of iron.

I will not conclude without remarking, that, although I give the preference to the pyrolignite of iron as a preservative, I do not exclude certain neutral salts, much in use, such as the chlorides of calcium and sodium, (muriate of lime and common salt.) These salts are likewise very efficacious, but only in cases where the wood is not constantly wet. The sulphate of soda is also useful, although it acts in the opposite way from those which I have just named. I have observed, also, that it dries wood with great rapidity. Fearing lest the hopes which I had founded upon the pyrolignite should be overturned by direct experiments upon wood, I took care to prepare some dozens of hoops with the chlorides of calcium and sodium, either alone, or mixed with the pyrolignite. These hoops were also placed upon barrels, along with hoops prepared with the pyrolignite alone,

and abandoned like them, and during the same length of time, to the destructive action of the damp air of the cellars.

The preservation was as perfect as that of the hoops prepared by the pyrolgnite alone, and in addition, the flexibility was maintained as perfect as it was upon the first day of the experiment. From which I conclude that the preservative powers of the alkaline chlorides in wood, which is not constantly in water, equals that of the pyrolignite.

I shall shortly present to the Academy facts of the highest interest upon this subject.

[TO BE CONTINUED.]

On the Fermenting Capacities of the Sugars. *By* HENRY ROSE.

Translated for the Journal of the Franklin Institute, from "Poggend Annalen," for 1841 (Vol. 52, No. 2.)

In chemical and technical works, it is customary to divide the varieties of sugar into those capable of fermentation, and those which are infermentable. Among the former, are ranked cane sugar and grape sugar; among the latter, those derived from milk, manna, &c. We know, however, since Pallas' "Travels in Siberia," that milk sugar may be made to ferment, and that the milk of the cow, or mare, will readily afford intoxicating liquors by fermentation; and Schill and Hess have latterly proved, by experiment, that the crystalized sugar of milk is fermentable. It is highly probable that this sugar is first changed into grape sugar, which then causes fermentation, but the change is very slow, and even other substances, which cannot be ranked with sugars, such as starch, and several kinds of gum, but which contain oxygen and hydrogen in the same proportion as water, pass into the vinous fermentation more readily than sugar of milk, by the addition of substances containing nitrogen.

It appears that our elementary works neglect noticing the great difference in the fermentability of cane and grape sugar, and yet the circumstance is undoubtedly of great interest in the arts. It is the more remarkable as the difference is so striking, that we might be inclined to rank cane sugar with those incapable of fermenting.

If to equal weights of grape and cane sugar, dissolved in equal quantities of distilled water, we add small but equal, quantities of yeast, the solution of grape sugar often commences to ferment at a medium summer temperature of 16° R. (68° F.) while the other remains unchanged. While the fermentation of the former may be accomplished in a few days, the solution of the cane sugar may remain unaltered after the lapse of several months, even if the temperature should reach 77° or 100° Fahr.

The grape sugar employed in these experiments was perfectly pure, and of a white colour; the cane sugar was pure and crystaline. An ounce of each was dissolved in five ounces of water, and pure yeast added to the solutions. In order to employ equal quantities of the latter, it was always used of the same pasty consistency, so that two small tea-spoonsfull weighing 1.57 grammes, when dried in a water-bath, gave a horny mass, weighing 0.27 grammes. This quantity of

barm was entirely sufficient to induce rapid fermentation in the grape sugar, while it left the other unchanged, after the lapse of a month. Indeed it requires six times as much yeast to bring the latter to a slow fermentation, so that if it were required to ferment solutions of the two sugars equally, and in equal times, it would be necessary to employ seven or eight times as much yeast with the cane as with the grape sugar. Common brown sugar acts similarly to the refined, requiring a large quantity of yeast to induce fermentation.

In the fermentation of cane sugar, it evidently passes first into the state of grape sugar, and the larger amount of yeast which it demands is necessary to bring about this change. The capability of fermentation of cane sugar depends, therefore, on the same principles on which several kinds of gum and milk sugar are subjected to fermentation, under certain conditions. They are changed by the action of several agents first into grape sugar, which then undergoes vinous fermentation. But the cane sugar suffers this change more readily than all other vegetable substances, and hence it is usually ranked among fermentable sugars. It can, however, be no more considered as a substance capable of the vinous fermentation, than starch, the gums, or even sugar of milk, the latter substances, it is true, suffering the change more slowly, and with greater difficulty. Grape sugar is, therefore, the only fermentable variety, and indeed the only substance which can be decomposed by yeast into alcohol and carbonic acid, and all substances which suffer the vinous fermentation must previously pass into the state of grape sugar.

Liebig discovered that ammonia is present in the sap of many plants containing cane sugar, such as the maple and birch.* It has long been known to exist in the juice of the beet root. Possibly the ammonia, in its carbonated state, saturated the acid in the sap, thereby preventing the latter from converting the cane into grape sugar. For we find that the latter, and not cane sugar, is contained in the juices of all fruits, which possess both a sweet and acid taste. It is very possible, and indeed highly probable, that this sugar was at first contained in the juices as gum, or perhaps as cane sugar, and that these substances are converted into grape sugar by the gradual action of vegetable acid. If a sweet organic substance contains acid, the sweet taste must depend upon the presence of grape sugar. It appears that fixed organic acids induce the formation of grape sugar. for I found that the fermentation of cane sugar is more accelerated by cream of tartar than by any other substance. An ounce of cane sugar dissolved in ten ounces of water, and treated with two teaspoonsfull of yeast, as in the above experiments, began to ferment upon the addition of a drachm of cream of tartar; acetic, or sulphuric acid, did not produce the same effect.

* Chemistry applied to Agriculture and Physiology.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks Relative to the Fossiliferous Ore of Pennsylvania, and its Employment in the Manufacture of Iron. *By* PROF. J. C. BOOTH.

In the course of a recent tour on the Susquehanna, I had an opportunity of making a few observations relative to the iron manufacture, some of which I believe to possess sufficient value to be laid before those who are interested in this foundation of national wealth. Indeed it is desirable that a freer interchange of sentiment should be maintained on this subject, and as many iron masters have made important observations in the course of their practice, I would suggest to them that their own interest lies in communicating such knowledge to the public, by its inducing a reciprocity on the part of others; for competition is less to be feared in this manufacture than in all others, since the consumption of iron will increase, at least, in proportion with its production.

The hematites, and other ores of Pennsylvania, having been worked advantageously for a great length of time, I paid more particular attention to the "fossiliferous ore," which is beginning to be more appreciated than formerly, and for very good reasons. It is regularly stratified, easy of access, always lies in the vicinity of lime-stone, and is, in all probability, of very great extent. For a more full and comprehensive view of this deposite, I refer to the excellent series of Geological Reports, particularly the 2nd, 4th, and 5th, presented to the Legislature of Pennsylvania, by Professor H. D. Rogers, which are based upon the extensive series of observations made by that gentleman and his assistants.

At the Duncannon iron works, I was shown a portion of chilled iron, from the hearth stone of a furnace in which the soft variety of the fossiliferous ore had been employed. Beside pure silica, which separates, and appears sometimes to have suffered fusion in this situation, a considerable quantity of pure metallic titanium was disseminated through the iron, and in a few points, it had separated somewhat in the form of a crystaline efflorescence, in which the cubical form could readily be detected with a microscope, and in many cases, even with the naked eye. Upon referring to the analysis of this ore, (Report 2nd, p. 44; 4th, p. 191 to 195; 5th, p. 115 to 117,) no trace of titanium being mentioned, should not excite surprise, when we recollect the difficulty of detecting it, unless its presence should be suspected, and when we reflect on the small amount in the ore that might be requisite to precipitate an appreciable quantity of it on the hearth-stones. Beside, since this metal does not appear to combine with iron, nor to affect its quality, its detection in the ore is a matter of inferior moment, and I have merely introduced a notice of its presence from the interest with which it is regarded by those engaged in scientic pursuits. Another method by which it may be detected is to observe when the slag assumes a fine blue colour, for

Karsten has lately discovered that this colour of the slag is due to the oxide of titanium.

A few hints may not be considered irrelevant in regard to the reduction of iron, which occurred to me in observing the ordinary processes, particularly at Danville. In roasting ores, which is generally regarded as an important preparatory step to their reduction, it is inadvisable to employ too strong a heat, for then the earthy materials and metallic oxide enter into a state of incipient fusion, which can be but imperfectly reduced in the furnace, and generally flow to the hearth in the state of slag. For although the carbonic oxide will act reducingly on its exterior surface, the inner, being completely enveloped in a compact cinder, can scarcely be affected. Probably the hard siliceous ore requires less heat than most of the other ores of iron, and indeed I give it as my conviction, that if the cost be not too great, it would be infinitely better to subject it to a coarse pulverization by mechanical means, since there is so small an amount of volatile matter in it, that simple roasting will not render it sufficiently porous. If roasting the ore be still adhered to, nothing should be more strictly watched than the object in view, which is to drive off volatile matter, and render the ore brittle and porous, and nothing can be more injudicious than to apply a heat which will cause the ore to cake together, or become cindery, since it is then more difficult of reduction than the ore in its original state.

Another point that cannot be too much insisted on is the due and proper mixture of ores, and it might almost seem as if nature pointed out the propriety of this, in presenting the three varieties of ore in the same locality. It is a well ascertained fact, that a very large quantity of lime is requisite to bring silica into a fusible state, such as is necessary in the operations of the iron furnace, while a small proportion of alumina, in addition to those substances, requires less lime, and a much less intense heat, to form a perfect slag, or glass. Now it appears, from analysis, Report 5th, p. 116, that the siliceous ore consists almost wholly of peroxide of iron and silica, with only one-half per cent. of alumina, and that the calcareous variety contains none, and Report 4th, p. 192, the hard ore contains a mere trace of alumina. In Report 2nd, p. 44, the porous and soft ore contains five per cent. alumina, and in Report 4th, p. 191 and 192, a similar ore includes five and six per cent. of the same earth. Hence it appears that the chief deficiency of the hard and calcareous ores lies in the want of alumina, which is contained in the soft ores; and that they should, therefore, be mingled in due proportion. If it is not always practicable to obtain a sufficient amount of aluminous ore for this purpose, the importance of having alumina present is such that it would become advisable to employ an argillaceous lime-stone as a flux, or even to use a clay, or other argillaceous material. If these points were to receive the attention they merit, I am convinced that iron masters would not so often complain of the difficulty of reducing hard varieties of ore.

Architecture.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A Description of the Philadelphia County Prison, and the Debtors' Apartment. Designed and Executed by THOMAS U. WALTER, *Architect.*

The Philadelphia County Prison is situated on the Passyunk road, about one mile south of the city. It occupies a space of 310 feet front by 525 feet in depth, with an addition on the north of 150 by 340 feet.

The façade consists of a centre building of fifty-three feet in width, with receding wings on either side, of fifty feet, flanked by massy octagonal towers. Beyond these towers, receding wing-walls are continued to the extremities of the front, and terminated with embattled bastions.

The whole exterior is composed of a blue sienite, obtained from Quincy, in the State of Massachusetts.

The style of architecture is that of the castles of the middle ages, and its decorations are in the *Perpendicular* or *Tudor* style of English Gothic.

The centre building is three stories in height, diminishing at each story in regular offsetts, capped with a projecting belt. The corners are finished with circular warder towers of five feet four inches in diameter, commencing at ten feet below the top of the front wall, and extending five feet above it; these towers project *three-fourths* of their circumference over the corners of the building, and are crowned with embattled parapets, supported by corbiels. The front wall, and both the flanks, are also finished with battlements, pierced with embrasures, thus forming an embattled screen between the towers, and imparting a tower-like effect to the whole centre building.

The wings are two stories in height, and contain the gates of entrance, each of which is ten feet wide, and seventeen feet high. These wings, and the octagonal towers which flank them, are pierced with slip windows, and finished with embattled parapets, in the same manner as the centre building.

The bastions, on the extreme angles of the front, are also crowned with pierced battlements corresponding with the rest of the design. They project two feet from the wing walls, and measure, on each face, fifteen feet in width at the base, and thirteen feet at the top.

The centre building is surmounted by an embattled octagonal tower, which rises to the height of seventy-seven feet from the ground.

The interior is disposed in two general divisions, one for untried

prisoners, and the other for male convicts, whose term of service does not exceed two years; the female convicts being confined in a building on the adjoining lot.

The main prison contains 408 separate cells, built in two blocks of *three* stories in height, extending from each wing at right angles with the principal front. The cells open into a corridor of twenty feet in width, occupying the centre of each block, and extending the whole length and height of the building. The second and third stories are approached by means of granite stair-ways and galleries, supported on strong cast iron brackets; a clerk's office is situated at the head of each corridor, from which every cell-door in the whole range may be seen at the same moment.

Each cell is nine feet wide, thirteen feet long, and nine feet high, substantially arched with bricks, and floored with oak plank. They are all furnished with separate hydrants, water closets, flues for ventilation, flues for admitting fresh air, and flues for admitting warm air, generated in furnaces placed in the cellar of the building.

The furnaces are constructed at each end, and in the centre of each block, and the warm air is conveyed along passages of *three* feet in width, under the pavement in the corridor. The smoke flues are formed in these passages, the bottom and sides of them being composed of bricks, and the top, of cast iron plates; these flues extend horizontally from the main furnaces at each end, to the centre, where they rise perpendicularly to the top of the building; an ascending current is produced in the vertical portion of each flue by means of small furnaces constructed in the centre, and which are also made to impart heat to the cells adjacent to them; by these means an active current is formed in the horizontal flues, and heat is conveyed along the whole range, in sufficient quantities to keep all the cells of an agreeable temperature.

Each cell has a wooden door on the outside face of the wall, and an iron one on the inside; both doors are secured to a cast iron casing, or frame, which extends through the whole thickness of the wall.

The hydrants and water closets are supplied from *twelve* reservoirs placed near the roof of the building; these reservoirs receive their water from the works at Fairmount.

The kitchen, bake-house, laundry, and bath-houses, are situated in a separate building, occupying a space of forty-three feet wide by seventy-two feet long, in the yard between the two blocks of cells; they are approached from both divisions of the prison, by means of covered passages.

The kitchen is furnished with a large steam boiler, and four cast

iron reservoirs, of eighty gallons each, in which all the boiling for the prisoners is done by steam.

The apartment for females is situated in an adjoining enclosure, of 150 by 340 feet, entered by a gate-way from the yard of the main prison; the building measures 43 by 282 feet, and consists of two stories in height, embracing 100 separate cells, of eight feet by twelve, a suite of rooms for an infirmary, of twenty by fifty-one feet, and two rooms for a keeper, each twenty by twenty. The arrangements for hydrants, water closets, warming and ventilation, are similar to those already described.

The principal entrance to this portion of the establishment, is from Eleventh street; it consists of a gate-way of nine feet in width, placed in the middle of a projecting centre of fifty feet, composed of brown sand-stone, and finished in the simplest style of Egyptian architecture. The whole western front is built of the same material, and in the same style.

The Debtors' Apartment.

This edifice is situated on the Passyunk road, north of the main prison, and east of the female apartment; it presents a front of ninety feet, composed of brown sand-stone, in the Egyptian style of architecture. The façade consists of a recessed portico, supported by two columns, proportioned from those of the Temple of the Sun, on the Isle d' Elephantine, in Egypt. The windows are crowned with the massy bead and cavetto cornice peculiar to the style, and the top of the building is finished in the same manner. A winged globe is carved in the cavetto of the main cornice, and a similar ornament is introduced over the door.

The aggregate cost of the whole work was upwards of $450,000; the County Prison was founded in 1832, and finished in 1835; the debtors apartment was built in 1836, and the apartment for females in 1837 and 8. T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1840.

With Remarks and Exemplifications by the Editor.

1. *For a Galvanic Paint for Protecting Iron from Decay by Rust;* Lewis Knapp, New York, July 1.

This patent was taken for "a process in the manufacture of materials for galvanizing iron, or protecting iron from decay by rust, or decomposition." The specification is one of much length, and a general outline of the process would occupy more space than we can

allow to it; we therefore simply give the claims, which are as follows, viz. "What I claim as new, and of my own discovery and invention, is first forming of a galvanic paint for coating utensils of iron by pouring a mixture of lead and zinc, or lead, zinc, and tin, on a quantity of copper and sal ammonia, placed in the bottom of a vessel, so as to form an oxide of said metals, and afterwards combining with the oxide so formed, a further quantity of copperas and sal ammonia, as described. Second, I claim as new, and of my own discovery and invention, the combination of a portion of lime with the galvanic powder so produced, when such combination is used, for the purpose of economizing the galvanic powder, and making the paint so mixed, harder, and more adhesive. Third, I claim as of my own invention and discovery, the mode herein set forth, of forming an alloy of zinc and lead, or of zinc, lead, and tin, by pouring a mixture of said metals, in a melted state, on a quantity of copperas and sal ammonia, which unites with the grosser parts, and allows the purer parts to escape through the bottom of the vessel, as described."

This compound is manifestly empirical, and must be inferior in its protective influence to the paint claimed under M. Sorel's patent, whilst if it possesses any good properties they are due to the same cause which gives value to the latter.

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2. For *Making and Attaching the Heels of Boots and Shoes;* Samuel Warner, of Lowel, Vermont, Jere Hodgkin, of Westfield, Vermont, and William E. Truver, Watervliet, New York, July 1.

The improvement consists in making a hollow shell of the form of the heel, either of metal, horn, bone, or ivory, which is to be attached to the boot, or shoe. The inside of this shell is to be filled up with India rubber, cork, leather, or other elastic substance. About midway between the bottom and top of the shell there is a flanch, by which it is screwed to the leather of the heel of the boot, or shoe.

The patentees say, "What we claim as our invention, and desire to secure by letters patent, is the manufacturing and attaching metallic, horn, bone, or ivory heel cases, the hollow part below the flanch to be filled up with India rubber, cork, or leather, or any other suitable material, and combining therewith, or attaching thereto, a spur, when necessary."

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3. For *Coupling Irons for Preventing Railroad Carriages from Running off the Track;* Thomas G. Owen, Baltimore, Maryland, July 1.

The coupling irons, which are the subject of this patent, are each made of two pieces, jointed together at one end, like a carpenter's rule. The holes through which the coupling pins pass are drilled through when the two pieces are closed, so that one-half of each hole is in each half of the coupling irons; one of them is made near to its jointed end, and the other at the distance of a few inches from the opposite end. When the coupling iron is in place its two halves are held together by the passing of that end which is not jointed, into a

mortise in a sliding bar, by which the two parts are held together whilst the two cars are in a line with each other, or whilst they deviate no further from this than is occasioned by the curvature of the track. But should the locomotive, or a forward car, run off the track, the coupling bar will be released from the mortise in the sliding bar, and its parts will separate from each other, and disengage the cars. The claim is to "the method of coupling railroad cars, or carriages, by means of the double coupling irons, in combination with the sliding bar, for the purpose, and in the manner, substantially, as herein described."

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4. For *Arranging the Cylinders of Steam Engines, so as to Prevent the Dead Point in the Crank;* Caleb L. Ferris, Courtland, West Chester county, New York, July 1.

The patentee says, "What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the horizontal and vertical cylinders, that is to say, I claim placing said cylinders (whether one be horizontal, and the other vertical, or otherwise, providing their relation to each other be still the same,) at right angles, or nearly so, with their closed ends adjoining each other, and the crank, or main shaft between them, at the junction of the angle, and operating the cranks by means of having the connecting rods of both cylinders attached to them."

The placing two steam cylinders, with their axes at right angles, has been heretofore done, and with the same object in view as that above stated; but the novelty, in the present instance, consists in the placing the two closed ends, or what usually constitutes their bottoms, close to each other, with the crank shaft so situated as to occupy the space between said closed ends. From the crank, or rather cranks, connecting rods extend to the pistons of each cylinder, in the ordinary way. By the above arrangement a great part of the room is saved, which was uselessly occupied by the connecting and operating parts, on the former plans of placing the two cylinders; so far, certainly, this may be considered as an improvement.

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5. For *Door Springs;* Gardner Barton, Sr., Shaftsbury, Bennington county, Vermont, July 1.

This is a spring for closing doors. A standard is attached to the upper part of the door, having a roller on the upper end of it, which roller acts against a lever attached to a segment of a cog wheel. The segment cog wheel turns on a pin, which connects it to a bar attached to the casement above the door, the segment mashes into a rack, which has a rod at one end of it, around which a spiral spring is wound. The spring is attached by one end to the bar, and by its elasticity forces the rack out, and acts upon the segment and lever, the latter of which, by bearing against the roller on the standard attached to the door, keeps it closed. The claim is to the combination and arrangement of the spring rack, segment, and lever, and the roller attached to the standard.

6. ***For a Portable Railway for Removing Earth, &c.;*** Jarvis Ring, Ogden, Monroe county, New York, July 1.

This portable railway is for removing earth, or other articles, to a short distance, and depositing it at one end of the railway. The description is given at great length, but the purposes to which it is to be applied are not very distinctly set forth. The cars, or trucks, are to run upon rails, extending the length of the apparatus, and are to return in an inverted position, under these rails; in order to enable them so to do, the ends of the upper rails are rounded, so as to form a semicircle, and around these the cars, or trucks, pass; when they have so passed, the wheels are supported on under rails, along which they return to the opposite end of the portable railway, where they ascend, by passing round a semicircular curve, and are ready to be re-loaded. The truck, or cars, are jointed, and otherwise so constructed as to enable them readily to pass round the semicircular ends of the track; they are connected together by a band, and motion may be given to them by means of a winch, or crank. The whole structure must, of course, be sustained by suitable frame work. The claim is to "making a double railway, with one track above the other, and rounded off at the ends, to unite the two, so that cars attached to endless chains, or belts, can run upon the two tracks."

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7. For improvements on the *Cylinder Mill for Grinding Corn;* Harvey W. Pitts, Wilsonville, Shelby county, Alabama, July 1.

Two cylinders of stone are placed side by side, and made to revolve with different velocities. Their axes are horizontal, and a double concave of stone is made to occupy the space between them on their upper sides, thus forming a rubbing surface between the concaves and each cylinder, equal to about one-fourth of its surface. A vibrating motion is given to the concave by means of a cam, or otherwise, and it is borne up against the cylinders by suitable means. The claim is to the "double vibrating concave, in combination with the fast and slow moving cylinders."

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8. For improvements in the *Steel Writing Pen;* David Thomas, Hingham, Plymouth county, Massachusetts, July 3.

These improvements in the steel writing pen consist in a peculiar mode of making the pen in two pieces, so formed as to give the elasticity above the nib, instead of to the nib itself; also in a manner of sustaining and securing the pen in the holder by means of set screws, and likewise in covering the holder with leather, gum caoutchouc, or any other elastic substance. Without the drawings the claim could not be understood; and we are apprehensive that the pens themselves will not pass into the hands of many of our readers.

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9. For a ***Machine for Drilling or Boring Rocks;*** Simon Petter, Schenectady, Schenectady county, New York, July 3.

The drill stock slides in bearings in a frame, which frame slides up

and down, in an inclined frame, the respective parts being made adjustable in such manner as to give to the drill any desired inclination. The first frame slides in grooves in the inclined frame, and its height is regulated by cords attached to it, and passing over a roller at the top of the inclined frame. The inclination of the inclined frame is regulated by passing the screw bolts, by which it is secured, through long slots in the upper and lower side-pieces of the main frame—the upper bolts also pass through slots in the side-pieces of the *inclined* frame, to allow for the increased distance between the upper and lower bolts, when the inclination of the frame is increased. There is a circular plate on the drill stock, the under side of which is provided with cogs, or cams, which are tangential to a circle about half the diameter of the plate, so that when the tappets, by which the drill is worked up and down, act against these cogs, or cams, in lifting up the drill, it insures the turning of the drill. The claim is confined to the combined adjustable and sliding frames, with the drill, and to the method of raising and turning the drill, by means of the cogs, or cams, on the plate, and the tappets.

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10. For an improvement in the *File for Filing Papers;* William Mann, Philadelphia, Pennsylvania, July 3.

This file, for letters and papers, consists of two covers, like those of a book, at the back edge of each of which there is a thin plate of iron—one of these plates is provided with two holes, to pass on to two screws attached to the other. The papers to be filed are placed between the two covers, and by means of nuts and screws, the whole is so compressed as to hold the papers. The nuts are halved, and each half is attached to a spring, the two springs being united together at their upper ends, in the manner of a crayon holder, and the two half nuts are brought together when it is desired to screw the file tight, by means of a slide, in the manner of closing that instrument. As the screws are necessarily very long, the nuts may be put on and taken off, by opening and closing the slide, so that they are not required to be turned on the screws, excepting to tighten and loosen the file.

The claim is to the "construction of the divided spring screw nut, opening by the elasticity of the springs attached to the two halves, and united at top, and made to close by means of the sliding ring, and adapted to the file, in the manner described, for filing papers and letters."

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11. For a method of *Attaching Artificial Teeth;* Alfred Riggs, City of New York, July 3.

The claim upon which this patent was granted, fully expresses the nature of the invention, and is as follows. "I rest my claim to invention, or improvement, in the making, or manufacture, of boxes, or plates, for mounting artificial teeth, upon the making, or forming, them of two parts, or plates, closely united together at the edges, so as to be air-tight, with a space, cavity, or hollow, between the plates,

either continuous, or divided into apartments. The inner plate, which rests upon the gums, being perforated with holes, more or less in number, through which the air is exhausted from the space, hollow, or cavity, between the plates, by suction, or otherwise, thus causing the boxes to adhere to the gums, by the pressure of the atmosphere, or air from without."

Perhaps teeth may be firmly held in this way, but to us it seems very doubtful, and most certainly, as a general mode, it cannot be applicable, the state of the gums and teeth, in most subjects, not admitting of such a mode of fastening.

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12. For improvements on the *Roller Gin for Ginning Cotton;* Fones M'Carthy, Demopolis, Morengo county, Alabama, July 3.

In front of the rollers there is a plate, which extends their whole length, and vibrates up and down; its upper edge is serrated, and is called by the patentee, "a vibrating saw;" immediately above this saw is an adjustable plate, which can be moved up and down, to regulate the distance between its lower edge and the vibrating saw. The bottom of the hopper, which is to contain the seed, lies directly in front of the adjustable plate, is horizontal, and is grated. The drawing roller is placed behind the vibrating saw, its upper surface being on a level with the saw—it is covered with leather, has a spiral groove running around it, and has a weighted roller above it. Behind this last named roller is a receiving roller, which is covered with cloth, and around which the cotton winds after it leaves the drawing roller; a vibrating comb placed behind this strips the cotton therefrom. As the cotton is drawn between the adjustable plate and vibrating saw, by the draw roller, the vibrating saw loosens and strips the seeds. The claim is limited to the "arrangement of the vibrating saw, adjustable plate, and grooved drawing roller, for separating the seeds from the cotton, in combination with the receiving roller and comb."

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13. For *Applying Distemper Colours in Painting, &c.;* Francis Gybbon Spilsbury, Fawny Corhaux, and Alexander S. Byrne, of Great Britain, July 10.

The patentees say, "The object of our invention, whether in preparing pigments, or paints, and vehicles, or in the mode of applying them, relates to means of using soluble vehicles for applying paints, or pigments, which vehicles, by an after application of chemical agents, or re-agents, are rendered insoluble in water, and will thus allow of paints, or pigments, so applied, and so fixed, to be afterwards washed, in order to clean them, and will, at the same time, admit of paints, or pigments, and vehicles, so employed, being applied for the most elegant purposes of house, and such like, painting, and also to the purpose of the artist, and for printing paper, and other fabrics, and, at the same time, in their use, they will not emit that disagreeable smell consequent on using oils, or spirits, or varnishes"—again, in giving the rationale of their invention, they say, "It is well known

that many chemical agents, or re-agents, when brought in contact with gelatin, or albumen, in solution, coagulates them, and such coagulated substances, when dry, are insoluble, and such is the case with other matters which, as well as gelatin and albumen, are employed as the soluble vehicles for mixing with pigments, in order to their being used as paints, and by the subsequent application of chemical agents, or re-agents, such vehicles are rendered insoluble, and the paints, or pigments employed, fixed, or set."

When gelatin is used as the soluble vehicle, alum is employed to fix, or give permanence thereto, the patentees deeming this the best of the chemical agents for rendering gelatin soluble in water.

The extracts above given will afford a good general idea of the nature of the invention, and as the specification and claims are of great length, and the latter not descriptive without the former, we omit them.

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14. For *Stoves, or Air-heaters, for Heating Apartments;* George C. Howe, City of New York, July 10.

A semi-cylindrical drum surrounds one-half of a cylindrical fire-chamber, leaving a space between the inside of the drum and the outside of the stone. On each side, near the top, a short pipe connects the chamber of combustion with the semi-cylindrical drum—another pipe passes directly through the back to the chimney, and an elbow pipe connects the bottom of the semi-cylindrical drum with the pipe that leads to the chimney beyond the valve employed therein, to close the direct draught. When the valve in the pipe that leads to the chimney is opened, the draught passes directly out; but when it is closed, and a valve, in the pipe which leads to it, is opened, the draught passes out on each side into the drum, and thence through a pipe into the exit pipe. The air of the room circulates through the space between the fire-chamber and drum, and thus becomes heated. The claim is to the manner in which the cylindrical stove and drum are combined, "by making the drum surround the back part of the cylinder, and leave an open space between it and the latter for a current of air to circulate through, as described." "And also to the arrangement of pipes and valves, in combination with the above."

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15. For a method of *Hanging Doors;* William D. Beasom, and E. G. Reed, Assignees of George W. Wilson, Nashua, New Hampshire, July 10.

The upper hinge of the door is to be made with two tongues on one half of it, and with one on the other half; the hole through the latter is made conical from either end, so that the pin attached to the two horns of the first named half, will be allowed some play. The lower hinge is made with a pivot on the half attached to the door, which rests in a socket in the other half; and this pivot, instead of being plumb under the axis of the upper hinge, stands out some distance, so that the weight of the door will always tend to close it, un-

less it be opened beyond a right angle, when it will have the opposite tendency.

The claim is to "the construction of the upper hinge in combination with the lower hinge, arranged and operating together." The particular arrangement claimed has some novelty, but the general plan is old, doors, and particularly gates, having been frequently hung upon this principle.

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16. For *Making Card Paper;* Edward L. Perkins, Boston, Massachusetts, July 10.

The machine used by the patentee, consists of an arrangement of rollers which carry a sheet of paper over a revolving brush, which brush receives the paste from a bed, which is supplied from a reservoir; this brush spreads the paste on the sheet, and another brush takes off the surplus, the paper is then carried to two pressing rollers, where it is united to another sheet of paper, which comes from a roller above. The claim is to the particular arrangement of the respective parts of the machine, referring to the drawings, and not capable of being understood without them.

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17. For *Boxes for Carriage Wheel Hubs;* Nathaniel C. Day, Lunenburg, Worcester county, Massachusetts, July 10.

The washer, or shoulder, of the arm of the axle-tree, against which the inside of the hub is to bear, is made conical, its greater diameter being towards the hub—a cavity is made in that face of it which is against the hub, for the reception of grease, which, when the axle-tree becomes heated, supplies grease to the rubbing parts. The box is provided with a cylindrical flanch, which extends over the washer, or shoulder, on the arm; and over this extends a *gravel guard*, which is a semi-cylindrical hoop, attached to the bed piece of the axle-tree. The patentee says, "what I claim as my invention, and ask a patent for, is the combination of the conical periphery of the washer, the grease reservoir, the flanch of the box, and the gravel guard, as above described."

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18. For *Preventing the Escape of Sparks from Locomotive Steam Engines;* Francis B. Longmire, and H. Jones Brooke, Philadelphia, Pennsylvania, July 10.

The patentees say, "In the apparatus which we have invented for preventing annoyance from sparks, we make use, as is usual, of the escape steam, for the purpose of creating a draught through the fire; but instead of extending the waste steam pipes upwards, into a vertical flue, in the ordinary way, we carry said pipes downwards, so as to pass within a flue under the boiler; said flue may extend along, into, or below, the ash-pit, under the fire-box, so as to cause the sparks, with the waste steam, and the gaseous products of combustion, to be discharged into a compartment prepared therefor, or into the ash-pit, allowing their final exit to be downwards, on to, or towards,

the ground. For the purpose of economising heat, we, in general, construct a metallic water box, or chamber, made flat, enclosed on all sides, and of such size as to occupy the area of the fire box, and this, by means of suitable tubes, we connect with the water tank, so as to allow water to flow into it; and we also connect with it the tubes of the supply pump, so that the water flowing in from the tank on one side, and heated to a considerable extent by the heat from the ash-pit, and from the escape steam, on its passage to the opposite side, may go to supply the boiler."

"Having thus fully set forth the nature of our invention, and shown the manner in which the same is to operate, what we claim therein, and desire to secure by letters patent, is the extending of the exhaust steam pipes downwards, and into a flue passing horizontally along under the boiler, into a compartment in the lower end of the fire box, which compartment may consist of the ash-pit, or of one specially prepared for the purpose, substantially in the manner set forth. We also claim the manner set forth, of locating and using a water box, constructed in the way, and employed for the purpose herein set forth."

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19. For a method of *Making and Attaching Buttons;* Festus Heyden, Waterbury, New Haven county, Connecticut, July 10.

The button is made in the manner of the common brace, or suspender button, except that there is but one hole in the middle of the concave part; and it is attached to cloth by means of a broad headed rivet, the shank of which is put into the hole from the back, and riveted on by means of a concave punch. The claim is in the following words, viz. "I claim the method of attaching buttons to cloth by riveting, and of manufacturing the parts for that purpose, combined in the manner, substantially as specified."

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20. For *Wooden Pavements, and Building Horizontal Platforms;* Redwood Fisher, of New York, Assignee of Augustus Count De Lisle, Paris, France, July 10.

The blocks are shaped to represent two parallelopipeds crossed diagonally, so that the two upper and two lower sides may be upon the same plane, and the top and bottom parallel to each other, or two parallelopipeds may be united together to represent the same forms. These may be made of iron, stone, wood, or of any other suitable substance. The blocks thus formed, are placed in ranges, so that the two extreme angles of the parallelopiped of one block will overlap those of a block in the next range. In forming beams, two, or more, ranges are put together, from one abutment to another, the middle or key block of each range being formed of two equilateral triangles placed side by side, an angle of one, and a side of the other, being upwards, and the other reversed. The inclinations of the parallelopipeds being inclined in opposite directions from the key towards each abutment. It is not possible to give a clear idea of this arrangement without drawings. The claim is, first to the "mode of forming

or shaping, materials, or substances, for building, paving, and other purposes, according to the divisions of the cube herein described; and secondly, to the mode of employing, in combination for building, paving, and other purposes, blocks, materials, or substances, so formed, or shaped."

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21. For a *Refrigerator;* John Scott, Philadelphia, Pennsylvania, July 10.

The patentee says, "I construct my refrigerators principally, or entirely, of sheet metal, and make them either in the form of a parallelogram, a vertical cylinder, or oval, or in any other shape that may be preferred. In whatever form I make them, they are to consist of two cases of sheet metal, one placed within the other, so as to leave a space of an inch, more or less, between the two, which space may be occupied by air, or may be filled in with any fibrous, or pulverized, bad conductor of heat. My principal improvement in such refrigerators consists in my forming a chamber for receiving ice, in the upper part thereof; and a second chamber for the reception of the water produced by the melting of the ice in the lower part, with suitable openings for the passage of the water from one chamber to the other, by the descent of which cold water every part of the apparatus is cooled."

"What I claim as new, is the forming it with an upper and lower chamber, in the manner described, the upper chamber being intended to contain ice, and the lower to receive the water produced by the melting thereof, said water descending from the upper to the lower chamber through tubes, or channels, constructed substantially in the manner set forth, so as, in its descent, to exert its refrigerating influence within the refrigerator."

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22. For *Truss Frames of Bridges;* William Howe, Warren, Worcester county, Massachusetts, July 10.

The following are the claims on which this patent was granted, viz: "What I claim as constituting my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the braces and counter braces, the double posts, and the wedges between them, so that by the driving of said wedges the truss frame may be cambered in any desired degree; I claim the manner of carrying the same principle into effect by the combined operation of the wedges, or keys, over the arch beam, and those between the posts. I claim the application of the same principle by an arrangement of braces and counter braces, combined with an arch beam, the wedges, or keys, for cambering, being driven between the principal and resisting braces, in the manner set forth, together with such other modifications, or variations, of the same principle by which the same end may be attained, by means substantially the same."

In the first modification claimed, the posts, along the truss frame, are double, and the braces and counter braces run from one half post to the half post of the second section, crossing by the side of the two

half posts that form the division between the first and second sections; and the second set of braces and counter braces start from the half posts crossed by the first braces in either direction, and so on. Strings, of course, embrace the whole on both sides. The wedges for cambering are driven in between the double posts.

In the second modification, the posts are split from the top nearly to the bottom, the wedges being driven in at the top. The braces and counter braces extend from the bottom of one post to the bottom of the next, in each division. An arch passes through the truss from end to end, embraced, or straddled, by each post, and a key is used where each post rests on the arch, so that by driving the keys on the arches, and those in the split posts, the frame is cambered. In the third modification, the braces and counter braces, instead of reaching from post to post, in each division of the truss, nearly meet in the middle, and the wedge is driven in between them, to give the camber.

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23. For a *Water Wheel for Driving Mills;* Joseph Hanchett, Cold Water, Branch county, Michigan, July 15.

The wheel referred to is a modification of the well known paddle wheel, in which the paddles are always kept vertical, by an eccentric guide wheel, or disk, at the side of the main wheel, the axis of each paddle having a crank, which works in the eccentric guide wheel, so that as the main and guide wheels revolve together the paddles enter and leave the water vertically, instead of radially. That which the patentee claims as an improvement consists of a method of changing the relative position of the main and guide wheels, so as to make the paddles enter and leave the water at a given inclination; and this is effected by having the shaft of the main wheel suspended in stirrups attached to two short shafts, on one of which the guide wheel works; on the end of these shafts are the levers, which change the position of the stirrups, and consequently the main wheel, relatively to the guide wheel. The line of the paddles will always be parallel with a line passing through the centre of the guide and main wheels.

The claim is as follows, viz: "What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the guide wheel upon the short axle, in combination with the main wheel, as suspended in stirrups fixed to the ends of short axles, turned by levers, for changing the position of the centre of the water wheel, in order to change the angle of the paddles, all as herein described." This, we suppose, will be just as good as some of the numerous analogous contrivances which have been made the subjects of patents, but neither of which has yet superseded the ordinary wheel, or even placed it in jeopardy.

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24. For *Dressing Staves for Making Barrels;* Hervey Laws, Wilmington, New Hanover county, North Carolina, July 15.

This machine is intended for the dressing of rived staves, or of such as may be made from saw-mill slabs. The pieces to be dressed are to be cut to a suitable length, and they are delivered from the machine

of the proper convexity and concavity on their sides, and with their edges jointed. The staves are dropped, or fed, into the machine through a suitable opening, and by means of a follower, worked by a crank motion, the stave is first forced along a trough-like cavity, between knives, or cutters, for the purpose of removing all superfluous stuff, and passing on, it is then forced between, and against, a series of cutting irons, operating as plane irons, and held in stocks by wedges, or otherwise; one set of these irons give to it its proper convexity, and the other its concavity. From this part, which dresses its sides, it passes on to the part where its edges are to be jointed; and this consists of a curved trough, continued on from the straight part, last described. The curvature of this jointing trough is such as will allow the stave to pass without bending it, but with its middle against the convex, and its ends against the concave side of the trough, and in thus passing it is jointed by a series of plane irons acting on each of its edges, in such manner as to give the proper rake to the joints, and the proper bulge to the stave. Each stave is forced on by the one immediately behind it, and they are delivered in a finished state with great rapidity. There are but few machines for the same purpose which are so truly original, and so far as we are informed, but few the action of which is so perfect.

The patentee says, "what I claim as constituting my invention, and desire to secure by letters patent, is the manner of constructing and combining the part for dressing the faces of the staves, with a curved box, as set forth, and furnished with a series of jointing irons contained in stocks forming the upper and lower portions of said box; the faces of said plane stocks approaching each other on the concave side of the interior of said box, for the purpose, and operating, substantially, in the manner herein set forth." "I also claim the said curved box for jointing staves, in its individual capacity, the respective parts thereof being constructed and connected, as herein described."

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25. For an improvement in the process for *Manufacturing Fair Leather;* John L. Turner, Philadelphia, Pennsylvania, July 15. (See specification.)

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26. For an improvement in *Fire Chambers for Stoves;* Benjamin F. and Job S. Gould, New York City, July 15.

These fire-chambers are of cast iron, and are fluted on their outsides like the shaft of a column, and their inner surfaces correspond in form with their outer, as they are of equal thickness throughout.

The patentees observe that "by the yielding nature of the arches, (swells, or ridges,) and the transmission of the same caloric through the sides of the chamber with diminished intensity of heat, owing to the additional extent for this transmission, without injury to the draught, the iron will be rendered far more indestructible, effecting an improvement which cannot be attained by any other mode."

The claim is to that mode of constructing the chamber of combus-

tion, or what is usually denominated the cylinder of a stove, with flutes, or ridges, as above described.

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27. For an improvement in the *Planing Machine;* James M'Gregor, Jr., July 15.

This improvement is made on a planing machine originally patented on the 28th day of August, 1833, and noticed in vol. xiii of this Journal, page 120, and on which a patent was obtained for further improvements, on the 9th day of January, 1838. A clear idea could not be given of the present improvements, excepting to a person well acquainted with the machine as formerly constructed; but the following extracts from the specification will afford some general idea of their object.

"My first improvement consists in a gauge for setting the irons when they are to be replaced after being removed, for the purpose of sharpening, by means of which gauge they are at once set to the proper rake and rankness, so as to require little, or no, further adjustment." "My second improvement is in the manner of constructing the sliding frame which governs the grooving saw." "I claim first the construction and use of the gauge for adjusting, or setting, to the proper rake and rankness, the cutting, or plane, irons; the same being made as described. Secondly, I claim the combining with the original sliding frame of the grooving saw of my planing machine, the adjusting frame, screw, and nuts, in the manner, and for the purpose set forth."

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28. For a *Log Brace for Saw Mills;* Benjamin Cushwa, Clear Spring, Washington county, Maryland, July 15.

"My log brace consits of a shaft supported on gudgeons, and crossing the floor of the mill beneath the carriage, at a short distance in front of the saw, said shaft having standards mortised into it, which support a friction roller, intended to sustain the log whilst being sawed. From this shaft there also extends an arm, by which the shaft and roller are held in place, and which arm is raised, and the roller lowered, as the rear end of the log approaches the saw."

"What I claim as constituting my invention in the within described improvement in saw mills, is the manner of using the shaft, carrying the friction roller for supporting logs on saw mills; the several parts connected therewith being combined together, and operating, in combination with the carriage."

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29. For improvements in the *Universal Chuck for Lathes;* Simon Fairman, Waterford, Saratoga county, New York, July 18.

This universal chuck is of the kind in which the holders, or pieces, which confine the articles to be turned, are moved simultaneously towards, or from, the centre of the chuck, by means of a convolute groove on a plate at the back. The first improvement is in the mode of uniting the front and back plates by means of a tube which projects from the back of the front plate, and unites it to the back plate,

the two being held together by a nut which screws on to the end of the tube. The inside of the tube is provided with a female screw to screw on to the mandrel. Whilst the chuck is on the mandrel the nut may be loosened, which will allow of the revolving of the back plate, on which is the convolute groove, to work the holders. The second improvement is in making openings in the outer rim attached to the front plate, through which that part of the holders, which slides in the plate, may pass, so that that part of the holders may be made long for a steady bearing, and be allowed to pass out through those holes in the rim, when any thing of great diameter is to be turned. The following is the claim. "I do not claim to be the inventor of the above described mode of working the holders by means of the convolute groove; but what I do claim as my invention, and desire to secure by letters patent, is the method of securing together the front and back plates, by means of the tube and nut, by which I am enabled to attach the front plate directly to the mandrel, or face plate, of the latter, all as above described. In like manner, I do not claim as my invention, the rim on the front plate, but what I do claim as my invention, is providing the rim with apertures, through which the slides, or holders, can pass, for the purpose, and in the manner above described."

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30. For an improvement in the *Parlour Grate, or Open Fire-Place;* Charles R. Wheeler, Boston, Massachusetts, July 18.

In this grate the jambs are made hollow, and divided into two flues, in order to cause the draught to ascend in one division, and to descend in the other; a cylinder, which runs from bottom to top, constitutes a part of the partition, and through this the air of the room circulates, and becomes heated. The claim is to "the construction of the hollow jambs, by making each of them with a vertical division plate, so as to conduct the smoke down on one side, and up on the other, in combination with the cylinders placed between said flues, for the purpose of heating the air of the room, as described."

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31. For improvements in the manner of *Constructing Kitchen Ranges;* Ebenezer Barrows, Rochester, Massachusetts, July 18.

The fire-chamber of this range consists of a cast iron cylinder placed within the square chamber generally employed in kitchen ranges—on each side of the fire-chamber there is an oven, the side plates of which are provided with an opening, to allow the heat to be radiated through this opening directly into the ovens, as the flues do not pass around them.

The claim is to the "manner of constructing and combining the three compartments constituting the fire-chamber and the side ovens, there being a free opening for the radiation of heat from the fire-cylinder contained in the former, into said side ovens, the latter being without flues around their sides, and their ends being formed of brick."

32. For improvements in the machine for *Cutting Match Splints;* John H. Stevens, Assignee of Elisha Fitzgerald, New York City, July 18.

This machine consists of a horizontally sliding gate, operated by a crank and connecting rod, and this is provided with a number of gauge teeth attached to a plate at one end, and a knife attached to it diagonally, extending from end to end. Above the knife-gate there is a box, in which the block, to be cut into splints, is placed, said box being provided with the necessary apparatus for holding, and for feeding, the block as the splints are cut off. At each stroke of the gate the gauge teeth pass under the block, and divide it into widths equal to the width of a match splint, and the knife then follows with an oblique draw cut, and takes off a plate as thick as the match splints. Each plate, thus cut off, having been previously divided and cut by the "gauge teeth"—the splints are thus completed. The claim is as follows:

"I do not claim as my invention any of the parts of the aforesaid machine, separately, and independently of their combination in said machine; nor do I claim as my invention, or improvement, any of the combinations in the above machine other than such as I have above specially named and claimed. But I do claim as my invention and improvement, the knife, having a diagonal drawing stroke, in combination with the points used as gauge teeth in cutting off and separating match splints by one operation, as described."

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33. For a *Machine for Planting Cotton Seeds;* Levin Miner, and Nicholas Felts, Yanceyville, Caswell county, North Carolina, July 18.

In this machine the planting is effected by a wheel placed on the axis of that on which the machine is sustained; the planting wheel has teeth on its periphery, which draw down the seeds from the hopper. The hopper consists of three parts, viz., a board, or piece of wood, having a square hole through it, and which is fixed to the beam directly over the planting wheel; the second part consists of a leather spout, the lower end of which is attached to the above named board, around the square hole; and the third part is in the usual form of a hopper, and is attached to the upper part of the leather spout. This third part is suspended by two cords from two springs to allow it to have a swinging motion, by which to prevent the seeds from adhering to the sides. The back part of the beam to which the coverers, and rake, &c. are attached, is connected to the other part of the beam by a joint behind the sowing beam. The handles are jointed to the forward part of the beam, and also to the back part.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the construction of the hopper, as before described, and the mode of supporting it, in combination therewith; and in forming the beam with a movable joint, to allow of the coverers and rake adapting themselves to inequalities of surface, and also in the

mode of attaching the handles to the movable and fixed parts of the beam, as described."

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34. For an improved mode of *Extracting the Alkaline Properties of the Ashes of Wood in the Manufacture of Pot and Pearlashes;* Jacob Osborn, Elyrica, Lorrain county, Ohio, July 18.

The claim on which this patent was granted, is as follows. "What I claim as my invention, and desire to secure by letters patent, is the addition and application of alum with lime and salt, in such proportions as will extract the whole of the alkaline properties of the ashes, and operate as a cleanser of the article produced." If the patentee would have the goodness to omit the alum and the salt, and employ the lime alone, we will venture to assure him that he would manufacture a more pure article; but then, it is true, he would not exercise the exclusive right to adulterate the alkali in his own way.

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35. For an improvement in *Cooking Stoves;* Lester Tilden, Barre, Washington county, Vermont, July 18.

The body of this stove is made for three boiler holes, one directly over the fire, and one at each end. The back plate is made in a triple curve, so as to concentrate the heat more perfectly around the boilers in the passage of the draught to the flues; from each of these curves a flue runs back to conduct the draught to three vertical pipes which communicate with the flue around the elevated oven, from whence it is taken by a pipe into the chimney. The vertical pipes are each provided with a damper, so that by closing, and opening them, or some of them, the heat can be divided, or concentrated, at pleasure.

Claim.—"Having thus fully described the manner in which I construct my cooking stove, what I claim therein as constituting my invention, and desire to secure by letters patent, is the triple curved form given to the back plate thereof, for the purpose of concentrating the heat upon the boilers, in combination with the elevated oven, and with the separate flues leading from the three compartments of the body of the stove to the three pipes which connect them with the oven flues."

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36. For a *Platform Balance;* Albert Dole, Bangor, Maine, July 18.

The levers in this balance are so arranged that instead of being suspended from the steelyard, and the weight on the balance pulling down, it pushes up, and the bearing is between the fulcrum and the weight; this is effected by having the platform rest on bearings, on the levers, outside the fulcra. Claim.—"What I claim as my invention and improvement, and which I desire to secure by letters patent, is constructing the levers with bearing points beyond their centres, or fulcrums, (fulcra,) for the feet of the platform to rest upon, and placing upon the end of the long lever a vertical rod, extending to the beam above, and upon which it rests, the whole as described."

What is the benefit derived from simply reversing the action of a part of the balance, in the manner described, is not very apparent, and the patentee has not pointed it out.

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37. For *Lottery Schemes;* Joseph Vannini, City of New York, July 18.

Whether lottery schemes belong truly to the class of *useful inventions*, may admit of doubt. That before us is somewhat intricate, is not very clearly set forth, and we should gratify but few of our readers by an attempt to analyze and display it; on our own part we should consider the time very unprofitably occupied, and shall, therefore, think that we have done enough in giving the claim.

"What I claim as my invention, and desire to secure by letters patent, is the mode herein described, of forming lottery schemes by making tickets with a series of ternary and binary combinations, with extra numbers on each ticket, and diminishing the number of tickets in every lottery, and regulating the drawing, in the manner set forth."

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38. For an improved *Mill Bush;* Jacob Aulabaugh, East Berlin, Adams county, Pennsylvania, July 18.

Several patents have been granted for mill bushes, very similar to that before us; the bush is made in sections, and is forced, and kept tight, against the spindle, by means of weighted wedges. The casing which contains the bush and wedges, is filled with oil, to lubricate the spindle; and the oil is prevented from running out of the holes, through which the rods pass that form the connexion between the weights and the wedges, in the following manner, viz. A shoulder, or flanch, projects from the upper back edge of each wedge, to which a rod is attached that passes through a hole made in a "stem," on which the back of the wedge slides; it being grooved out for that purpose. The lower end of each rod is attached to a weighted lever.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of preventing the escape of the oil at the apertures through which passes the connexion between the weight and wedge, by the combination of the rod attached to the weight, the hollow stem, and the opening in the wedge into which the hollow stem fits, as herein described."

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39. For an improvement in *Hydrants and Fire Plugs;* S. H. Davis, Cincinnati, Ohio, July 18.

The valve seat of this hydrant is attached to the lower end of a copper tube, through which the water is to be discharged, and its lower end screws on to the street pipe. The valve is attached to the lower end of a rod, and is closed by being drawn up against its seat. The valve rod passes through the upper end of the copper tube, and is surrounded by a spiral spring, which acts against a shoulder at the upper end of the rod and the top of the tube, and the tension of the spring keeps the valve closed. Above the valve seat there is a ring

attached to the sides of the chamber by means of arms, allowing the water to pass between the outside of the ring and the inside of the tube—the valve rod passing through its centre. The valve rod is provided with a collar faced with leather on the under side, a little above this ring, and the ring has a hole made in its upper surface, which passes through one of its arms, and through the tube. When the valve rod is pressed down, the leather on the collar closes the hole in the ring, and opens the valve, which allows the water to flow up, and out of the pipe, but when it is liberated, the tension of the spring closes the valve, which stops the flow of water, and opens the hole in the ring, through which the water in the tube is discharged, to prevent freezing.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is placing the valve seats in a separate chamber, which is adapted to, and made to screw on a chamber connected with, and opening into the main pipes, and fitting to the valve seats in said chamber, valves placed on a vertical stem passing through a tube connected with the upper part of the chamber, said stem being operated by springs, in the manner, and for the purpose herein set forth."

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40. For an improvement in the *Spindle and Trundle Head of Mills;* Eldridge G. Potter, Lebanon, St. Clair county, Illinois, July 18.

The proposed improvement is for forming the connexion between a trundle head and its spindle, to prevent the "backlash." Instead of having the trundle head fixed to, it turns freely on the spindle, and is provided with arms, that act against springs attached to the spindle, and by this connexion the spindle is put in motion. The claim is confined to this device.

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41. For an improvement in the *Thumb Latch;* Philos, Eli W., and John A. Blake, New Haven, Connecticut, July 21.

This patent was granted for some modifications of the thumb latch, which, although but slight, will be important to the manufacturer. As the claims could not be understood without a full description of the modifications, which would require drawings to illustrate them, they are omitted. The improvements consist of a peculiar manner of arranging the thumb lever, so as to dispense with the fulcrum pin, and in the formation of some of the other parts of the latch, by which they can be cast more perfectly, and with greater facility than heretofore.

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42. For *Machinery to be Employed in Turning Various Articles;* John Clark, Jr., Glasgow, North Britain, July 30.

A number of mandrels are ranged around a circle, with their axes parallel to each other; to each of them a rotary motion on their own axes is communicated, and they, at the same time, are made to travel around the centre of the circle, around which they are ranged. The articles to be turned, or shaped, are properly attached to these man-

drels, and as they travel round they come in contact with rotary, or permanent, cutters, rasps, &c., properly arranged within and without the circle; or the mandrels may be ranged in a straight line, and whilst they have a rapid rotary motion on their own axis, they, at the same time, traverse in a straight line, and are thus brought in contact with a series of rotary cutters, &c. &c., arranged in a straight line. The claim is to "the combination of machinery, whereby a number of articles to be turned are arranged parallel to one another, in a circle, or straight line, and made to pass by a series of rotary, or stationary, cutters, grinders, &c.

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43. For a *Smut Machine;* Hiram Smith, Bethany, Genessee county, New York, July 31.

This machine consists of a vertical cylinder with beaters thereon, ranged around in sets. These beaters revolve in a cylindrical casing, which is provided with ledges, or flanches, running around in the direction of the diameter, one between each set of beaters; the casing is furnished towards its upper and lower ends with vertical apertures similar to those of venetian blinds. The inner surface of the casing and the ledges are rough. The grain is fed in at the top, and discharged at the bottom. Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the mode of constructing the cylinder by forming it with circular ledges and oblique apertures, in combination with the revolving beaters, constructed, and operating in the manner set forth."

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44. For improvements in the *Mariner's and Surveyor's Compass;* William C. Poole, Lancaster, Pennsylvania, July 31.

The patentee says—"The nature of my invention consists in a fixture, to be attached to either a surveyor's, or mariner's, compass, by means of which the absolute variation may be ascertained by the meridian sun. This fixture is provided with reflectors, one movable, placed at right angles with the sights of the compass, and the other, stationary, attached to one of the sight vanes, in which an observer may, by the action of the moving reflector, see the sun at meridian."

"What I claim as my invention and discovery, and desire to secure by letters patent, is the method herein described of obtaining the meridian line, and thereby ascertaining the variation of the needle, by means of a compass constructed with a fixed and movable reflector."

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45. For a *Balance, or Scale Beam;* Seth E. Winslow, Philadelphia, Pennsylvania, July 31.

A peculiar manner of making the fulcra of a scale beam is the subject of this patent. Instead of having the fulcra, on which the beam rests, separate from those of the shackle, to which the articles to be weighed are suspended, the two sets are made of one piece of metal, and may be brought very near together. A piece of metal of the requisite size for the axis of the beam is taken, and its lower side is

reduced to an edge; this edge is then rolled, or turned up, at an angle of 180°. A portion is then cut away from each of the ends, which are formed so as to constitute the usual knife edge bearings, or fulcra. The shackles are made with holes of sufficient size, and of the necessary form, to pass over the body of the axle on each side of the beam, and rest upon the turned up edge, and that part of each end which is formed in the usual way, projects beyond the shackle, and rests in the holes of the suspending shackle. The claim is confined to the "construction of the single axle with double fulcra, as described."

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46. For *Making, Ruling, and Cutting Paper;* John Ames, Springfield, Massachusetts, July 31.

In this machine the ruling machine is combined with the cutting and drying part of a paper making machine, in such manner that as the paper leaves the drying cylinder it is conducted to a roller with a set of pens, which rules it on one side, and thence to another, which rules it on the opposite side, whence it passes to the machine, which cuts it into sheets. The second ruling machine has a cam, which lifts the pen at certain regulated distances, for the purpose of ruling letter paper, which is ruled on three sides only. Claim.—"What I claim is the combining of the ruling and cutting machines with the drying cylinder, from which drying cylinder the paper is delivered in an endless sheet; said combination being made substantially in the manner herein set forth; the paper, when required, being successively ruled on both sides, by means of two ruling cylinders and their appendages, in the manner described, and being conducted from the last cylinder to the cutting machine, also as described.

I likewise claim, in combination with the ruling and cutting apparatus, the manner of raising the pens on the second ruling cylinder, by means of the cam and its appurtenances, so as to leave the required portion of the paper unruled."

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47. For improvements in *Portable Baths;* J. Wright Warren, Jr., Boston, Massachusetts, July 31.

The patentee says—"The object of my invention is to combine in one arrangement all the conveniences for taking all the several descriptions of baths, such as warm, cold, vapour, medicated vapour, and shower baths, said arrangement being constructed with due regard to simplicity and portability."

The apparatus is arranged like a couch, the box for containing the water being provided with a hinged cover. This cover is pierced with holes, for taking the vapour baths. The apparatus for generating the vapour, whether medicated or not, is separate from the other parts, the vapour being admitted through suitable pipes. The apparatus for the shower bath is suspended from the upper part of the machine; it would be useless to give the claims, as they refer throughout, to the drawings.

Specifications of American Patents.

Specification of a Patent for an Improvement in the Process of Manufacturing Fair Leather. Granted to John L. Turner, *of Philadelphia, Pennsylvania, July 15th,* 1840.

To all whom it may concern: Be it known that I, John L. Turner, of the City of Philadelphia, State of Pennsylvania, have invented, or discovered, an improvement in the process for manufacturing that kind of leather which is technically denominated *fair leather*, and which is used by saddlers, coach makers, book binders, and others, for various purposes in the useful arts; and I do hereby declare that the following is a full and exact description of my said improved process, for the purpose of giving to fair leather that light appearance, and that particular colour, which is required in its various applications. I take it in that part of the process of manufacturing it subsequent to its having been thoroughly scoured, set out, and stuffed, preparatory to the process of drying, and in this state I take sulphuric ether, and with a brush, or other suitable article, I wash, or spread over, this fluid, on the face of the leather which is to be whitened. Before performing this operation, I prepare a mixture of tallow and spirits of turpentine, incorporated in such proportion as to have the consistence of thick oil; and with this I immediately, in like manner, pay over, or cover, the surface of the leather, which is then ready to be dried in the usual manner.

By the action of the sulphuric ether, the required whiteness, or fair appearance, is given to the leather, but if it is dried after the application of the ether, without that of the tallow and spirits of turpentine, or of some analogous softening material, there will be a degree of harshness, and want of pliability, produced upon the surface, which is objectionable, and which, by the means prescribed, is entirely removed. Having thus fully described the nature of my improvement in the process of manufacturing what is known under the denomination of fair leather, and shown the manner in which I carry the same into effect, what I claim therein as constituting my invention, or discovery, is the employment of sulphuric ether, to produce the required light, or fair appearance, in such leather, in the manner, and under the conditions, substantially as herein set forth.

It is highly probable that some other of the etherial fluids, such, for example, as nitric, or muriatic ether, would produce an effect similar to that produced by sulphuric ether, but as the latter is perfectly effectual in its operation, and can be most economically obtained, I have not thought it necessary to essay the other kinds, but I do hereby declare that I do not intend to limit my claim to the use of sulphuric ether alone, but that I embrace therein, and intend to use, any of the fluids properly denominated ether.

John L. Turner.

Remarks by the Editor.—We give the foregoing specification not

because we think the *invention* one of great importance. When this patent was issued we were entirely at a fault in endeavouring to discover the rationale of the process; and we have been subsequently informed by a respectable and intelligent manufacturer, who has essayed it, that the intended effect is not produced by the means set forth. If this is the fact, and the patentee has not told "the whole truth," he has not fulfilled the requirements of the law, and his patent is a nullity.

Specifications of English Patents.

Specifiation of a Patent Granted to Gerard Ralston, *of the City of London, for Improvements in Rolling Puddle Balls, or other masses of Iron,—being a Communication.* [Sealed 22nd of February, 1840.]

These improvements in rolling paddle balls, or other masses of iron, consist in the employment of a peculiar construction of machine, for the purpose of compressing, and rolling out, red hot balls, or masses of puddle iron, into that state commonly called bloom, preparatory to the mass being rolled down into bars, or plates, or operated upon by tilt hammers.

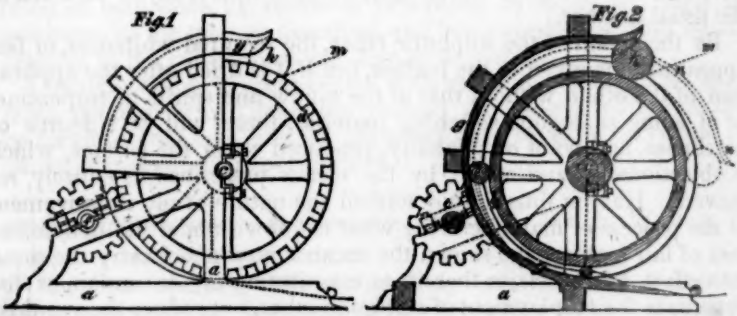

Figure 1 represents a side elevation of the machine; and fig. 2 is a section taken vertically through the rolling cylinder. *a*, *a*, *a*, is the framework supporting the machinery, which framework may be of cast iron, or any other suitable material. *b*, *b*, is the rolling cylinder, turning upon an axle *c*, *c*, supported by the side frames; and *d*, *d*, are toothed wheels, affixed to the ends of the cylinder. *e*, is one of two pinions, or small wheels, upon a shaft *f*, also mounted upon the framework; which pinions, or wheels, being driven by any convenient power, and taking into the teeth of the wheels *d*, *d*, cause the cylinder *b*, to revolve.

A segmental piece of iron, *g*, *g*, is firmly fixed to the framework,

partially embracing the cylinder *b*, *b*; but in an eccentric position to the periphery of the cylinder, as shown in the section, fig. 2. Between this segment piece, and the cylinder, the ball, or mass of red hot puddle iron *h*, is passed, for the purpose of rolling and compressing it.

The large ball, or mass of iron, having been prepared in the puddling furnace in the ordinary way, it is to be introduced into the machine, as shown at *h*. Rotary motion being given to the cylinder as described, the mass of iron will be carried forward between the cylinder *b*, and the segment piece *g*, by which it will be gradually compressed and reduced in its diameter, increasing in length until it is ultimately delivered out at bottom in the form of a roll, or long cylindrical piece, ready to be taken to the tilt hammers to be drawn out, or to the ordinary rollers, where it may be rolled into a bar, or sheet.

It may be here remarked, that the mouth of the segment piece *g*, should be made nearly simicircular, which form it partially retains for the purpose of compressing the mass on all sides during one or two rotations of the ball; but that its groove thence gradually widens out towards the end; which form is for the purpose of confining, or upsetting the ends of the mass of iron under operation.

The patentee claims, first:—The entire machine, as above arranged, for rolling, or shaping, puddle balls, or other masses of iron, preparatory to being rolled, or even drawn into a bar by the hammer; but he states, the outside casing might be brought farther down in front of the machine, as represented by the dotted line *n*, *n*, fig. 2; which arrangement improves its operation, giving a greater number of revo lutions to the ball,—consequently reducing it more gradually.

Secondly:—He claims the plan of laying the above named machine in a horizontal position, when found better adapted to the situation where it is placed, and so altering it as to permit the upper flanch, or edge, of the segment piece, to rise and fall, to admit of a larger or smaller ball. The weight of the said flanch being so proportioned as to upset the ends of the ball, or bloom, sufficiently.

The same effect may be also produced by a cylinder, revolving within a stationary curved casing, as above described; or by a straight plate of iron, held stationary, in lieu of the above-described casing; while another, shaped like a wedge, is confined at a suitable distance apart, and moved by a crank; thus rolling a ball into a bloom each revolution of the said crank, the principle being one and the same.

Lond. Jour. Arts and Sciences.

Specification of a Patent Granted to PIERRE ARMAND LE COMITE DE FONTAINEMOREAU, *of Skinner's Place, Sizelane, for Certain Improvements in Covering and Coating Metals and Alloys of Metals. February 15th*, 1841.

These improvements relate to an improved mode of covering or coating certain metals or alloys of metals, with gold, silver, or platinum.

Firstly, of gold; this process is particularly applicable to coating or covering copper and its alloys, to silver and its alloys, and to some other alloys more or less alloyed with copper; to iron, tin, bismuth, antimony, and to the several alloys of these metals.

In all cases, the first operation consists in preparing or cleansing the article to be coated, or covered, after the workman has given it the precise form which it is to retain; for this purpose it is heated to redness, and when moderately cooled, it is to be quenched in water slightly acidulated with sulphuric acid. A bath is prepared by adding one part (by weight,) of sulphuric acid to one part of water and two parts of azotic acid, into which the goods are to be placed. When the articles begin to turn black, they are to be taken out of this bath, and thrown into azotic acid of thirty to thirty-six degrees of Beaume's areometer, when they will become of a fine bright yellow colour, and are to be washed in fair water and scratch-brushed. The work is then to be burnished in such parts as are to be finished in that way. Silver articles are to be cleaned by heating them, and then throwing them into acidulated water, and letting them remain for three or four hours, or until they become white, when they are to be taken out and scoured with water and fine sand.

A solution of gold is prepared by dissolving pure gold in a finely divided state in brome or chlorine, or in some azote chlorohydric acid, or in some azote iodydric acid; this solution is evaporated to the consistence of sirop.

The operation may then be conducted by any one of the following five methods, which constitute five different modes of gilding, the first being preferred.

First Bath.—Four hundred parts (by weight,) of distilled water are to be placed in an enamelled iron pot, and made tepid, when seventy parts hydrated oxide of barium, hydrate of barytes, or seventy parts hydrated oxide of strontium, hydrate strontites, are added. When these are dissolved, the gold solution is added, and the whole boiled together; as soon as the mixture begins to turn purple, the articles of copper, or its alloys, are to be immersed therein. On being taken out they are first dipped in acidulated water, afterwards in fair water, scratch-brushed, and dried off in sawdust. If silver articles are to be gilded, they must be covered with copper wire, otherwise they will not take the gold.

Second Bath.—Common water is to be used instead of the distilled water, with forty-five parts, by weight, of oxide of lithin, to which the solution of gold is to be added, and the operation conducted as before.

Third Bath.—Three parts of gold prepared as before, 1,000 parts water, 125 parts quicklime, or seventy-five parts of magnesia, besides twenty-five parts chlorine of calcium, or chlorine of magnesia, are boiled together, and used as before.

Fourth Bath.—Eight parts of gold in solution, fifty to eighty parts of oxide of zinc, 100 parts of water, and 350 parts chlorine of zinc, boiled, &c., as before.

Fifth Bath.—Five parts of gold precipitated by oxide of zinc, 500

parts distilled water, 250 parts chlorine of barium, or strontium, zinc, lime, or magnesia, boiled, &c. as before.

Secondly, for coating, or covering, articles with silver. Ten parts of silver are dissolved in azotic acid, evaporated to dryness, and then re-dissolved in distilled water. Into an enameled iron pot put 5000 parts of water, 900 parts of chloride of barium, or of strontium, of lime, magnesia, or zinc; to these add from 1000 to 1400 parts of cream of tartar, and boil the mixture; then add the silver solution, with twenty-five parts boric acid. The articles to be silvered are to be plunged in, and when the coating is strong enough, taken out, washed in tepid water, scratch-brushed and dried.

Thirdly, for coating and covering metals with platinum, a solution of two parts of platinum in azotic acid, chlorohydric, or boric acids; when evaporated nearly to dryness add forty parts of distilled water, fifteen parts chloride of barium, or of strontium, lime, magnesia, or zinc, or chloride of ammonia, and boil them together. The articles are to be immersed till they take a grey coat, they are then to be thrown into water, well washed, scratch-brushed, and dried.

The claim is, 1. The use of the substances named in the first mentioned process, for coating and covering metals and alloys with gold, as well as all the salts of their bases, either alone or combined with other substances; the substances being barytes, strontites, lithin, lime, magnesia, and their salts.

2. In the process for coating and covering with silver, the chlorines of barium, barytes of sodium, of strontium, strontites of lime, of magnesia, and of zinc, either alone, or mixed with other substances; and the mode of operating with them.

3. In the process of coating and covering with platinum, the use of double chlorines of platinum and of barium, barytes of strontium, strontites of magnesia, lime, ammonia, and zinc, alone, or combined. Also the oxides and salts of these bases, either alone or combined with the salts, or oxides, of platinum. Mech. Mag.

Specification of a Patent granted to Joseph Leese, Jr., *of Manchester, for Certain Improvements in Printing Calicoes and other Surfaces. December* 24, 1840.

The first of these improvements refers to the employment of a peculiarly formed fabric instead of the blanket usually employed in calico printing. This is composed of several layers of calico or other suitable fabrics, coated and cemented together with a solution of India rubber; the ends being joined, an improved endless fabric is formed, having the necessary elasticity in its thickness, but non-elastic in its length and breadth.

The second improvement relates to what is technically called "rainbowing," which is performed in the following manner; a number of sieves containing the different shades of colour are placed nearly under each other; over each sieve a disk revolves, having projections of copper wire, or other suitable material, which dip into the colours. These

disks are supported on pedestals which admit of easy adjustment, and are so regulated, that as they revolve, the projecting wires give colour to the cylinder in successively lighter shades, which are imprinted on the fabric under operation.

A third improvement relates to printing blocks, which are to be covered with a surface of India rubber, through which the pattern is to be cut, its sides being supported by a thin metal edging. This arrangement will, it is said, greatly increase the durability of the block, while the pattern will be much better printed on the calico, &c.

Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, OCTOBER, 1841.
COMPUTED BY JOHN DOWNES.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.
☞For direct vision add 180°.☜

Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	7	35	Im. 101 Piscium,	6	157°	104°
1	8	24	Em.		264	212
6	15	47	Im. ν Geminorum,	6	44	253
6	16	32	Em.		321	298
31	16	28	Im. χ Tauri,	6	102	159
31	17	39	Em.		261	319

Meteorological Observations for July, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	72	88	29 85	29 80	W.	Moderate.		Partially cloudy—clear.
	2	72	81	.80	.85	W.	do.		Cloudy—clear.
⊙	3	60	77	.90	.90	E.	do.		Clear—do.
	4	56	79	.92	.92	N.	do.		Clear—do
	5	61	84	.86	.80	W.	Brisk.	.34	Partially cloudy—clear—rain.
	6	64	82	.75	.75	W.	Moderate.		Cloudy—clear.
	7	70	79	.75	.80	W.	do.		Lightly cloudy—do.—do.
	8	62	80	.80	.90	W.	do.	.30	Cloudy—clear.
	9	62	80	.96	.95	W.	do.		Clear—clear.
	10	69	80	.79	.79	NW.	do.		Cloudy—clear.
	11	60	75	.87	.84	NW.	do.		Clear—clear.
☽	12	59	77	.80	.78	W.	do.		Flying clouds—clear.
	13	64	81	.76	.76	W.	do.		Lightly cloudy—do.—do.
	14	70	85	.76	.77	W.	Brisk.	.35	Cloudy—clear—rain.
	15	70	85	.77	.77	W.	Moderate.		Partially cloudy—do.—do.
	16	70	90	.77	.77	E W.	do.		Clear—do.
	17	62	78	.93	.94	W.	Brisk.		Clear—do.
	18	62	84	.94	.94	S. SW.	Moderate.		Clear—do.
⊗	19	62	84	.93	.96	S. SW.	do.		Clear—do.
	20	66	87	30.07	30.08	SW	do.		Clear—do.
	21	61	85	.23	.08	SE.	do.		Clear—lightly cloudy.
	22	70	84	.12	.05	SW.	do.		Cloudy—partially cloudy.
	23	70	88	29 96	29.96	SW.	do.		Clear—clear.
	24	72	90	.93	94	SW.	do.	.17	Clear—lightly cloudy.
☾	25	76	94	.89	.82	W. SW.	Calm.		Cloudy—par. cloudy—rain in night.
	26	70	79	.83	.91	NW.	Brisk.		Clear—clear.
	27	60	79	99	.66	NE.	Moderate.		Clear—cloudy.
	28	68	82	.98	.85	NE.	do.		Lightly cloudy—do.—do.
	29	53	77	30.00	30.00	NE.	do.		Clear—do.
	30	64	73	29 90	29.90	NE.	do.		Partially cloudy—cloudy.
	31	66	65	.70	.70	E.	do.	1.75	Rain—do.
	Mean	65.45	81.48	29.89	29.87			2 91	

	Thermometer.		Barometer.	
Maximum height during the month,	94 00	on the 25th.	30.23	on the 21st.
Minimum "	56.00	" 4th.	29.66	" 27th.
Mean	73.47		29.88	

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

SEPTEMBER, 1841.

	County.	Town.	Observer.	Thermometer. 7, A.M.	2, P.M.	9, P.M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barometer. 7, A.M.	2, P.M.	9, P.M.	Maximum.	Minimum	Mean.	Days omitted.	Clear.
1	Philadelphia,	Philadelphia,	E. W. Hamilton,	64.04	72.19	66.70	84.00	54.00	67.64	8	40.00	56.87	7	30.12	30.08	30.04	30.34	29.72	30.08	6	19
2	Montgomery,																				
3	Bucks,	Newtown,	L. H. Parsons,	60.27	71.39	59.90	83.00	47.50	63.85	⅔	46.50	56.18	..	30.03	30.00	30.03	30.31	29.62	30.02	⅔	17
4	Lehigh,																				
5	Northampton,																				
6	Monroe	Stroudsburg,	A. M. Stokes,	52.79	64.27	.....	75.00	45.00	39.02	20½	.....	.....	..	29.54	29.52	.....	29.80	29.20	29.53	20⅔	1⅓
7	Pike,																				
8	Wayne,																				
9	Susquehanna,	Silver Lake,	E. Rose,	55.57	71.30	64.87	84.00	47.00	64.58	.	47.00	54.53	..	27.72	27.72	27.73	28.31	27.05	27.72	.	11⅔
10	Luzerne,																				
11	Schuylkill,	Port Carbon	P. C. Lyceum,	55.93	63.76	58.86	90.00	39.50	59.52	2⅔	.....	.....	..	29.34	29.37	29.35	29.60	29.00	29.36	2⅔	9⅓
12	Berks,																				
13	Chester,																				
14	Delaware,	Haverford,	Haverford School,	66.08	75.15	68.00	82.00	63.00	69.74	17⅓	60.00	64.55	19	29.52	29.48	29.49	29.73	29.22	29.50	18	.
15	Lancaster,	Lancaster,	Conservatory of Arts,	61.50	74.85	63.77	86.00	49.00	66.71	⅓	48.00	59·93	..	29.53	29.50	29·52	29.80	29.14	29.52	⅓	16⅔
16	York,																				
17	Lebanon,																				
18	Dauphin,	Harrisburg,	J. Heisely,	65.37	72.80	69.63	83.00	56.00	69.27	.	54.00	61.90	..	29.73	29.71	29.72	30.02	29.45	29.72	.	.
19	Northumberland,	Northumberland,	Andrew C. Huston,	62.13	70.63	66.17	80.00	53.00	66.51	.	42.00	54.18	..	29.49	29.47	29.48	29.79	29.10	29.48	.	10⅓
20	Columbia,																				
21	Bradford,																				
22	Tioga,																				
23	Lycoming,																				
24	Union,																				
25	Mifflin,																				
26	Juniata,	Mifflintown,	J. A. Kinkead,	56.62	70.13	63.12	87.00	39.00	63.29	1⅔	.....	.....	..	29.48	29.44	29.46	29.78	29.11	29.46	1⅓	11⅔
27	Perry,																				
28	Cumberland,																				
29	Adams,	Gettysburg,	Prof. M. Jacobs,	59.87	73.54	63.85	88.00	47.00	65.75	⅓	45.00	57.33	..	29.42	29.39	29.39	29.65	29.11	29.40	.	17⅔
30	Franklin,																				
31	Huntingdon,	Huntingdon,	Prof. Jacob Miller,	67.33	70.07	70.23	92.00	46.00	69.21	⅔	.....	.....	..	29.38	29.36	29.37	29.66	29.08	29.37	⅔	20
32	Centre,	Bellefonte,	John Harris,	58.23	74.40	61.24	89.00	43.00	64.62	2	.....	.....	..	29.32	29.29	29.28	29.60	29.01	29.30	2	14⅓
33	Potter,																				
34	M'Kean,	Smithport,	M. R. Atkins,																		
35	Clearfield,																				
36	Cambria,	Ebensburgh,	Richard Lewis,	55.93	78.86	58.47	89.00	39.00	64.42	3⅓	40.00	52.50	2	27.88	27.88	27.84	28.11	27.58	27.87	3	8⅓
37	Bedford,	Bedford,	Samuel Brown,	60.56	75.96	66.72	9	.00	44.00	67.75	.	.....	..	29.27	29.26	29.25	29.50	28.95	29.26	.	17⅔
38	Somerset,	Somerset,	George Mowry,	55.82	68.35	58.33	82.00	40.00	60.83	9	40.50	50.19	9	27.84	27.85	27.83	28.09	27.60	27.84	9	9⅓
39	Indiana,	Indiana,	Richard White,																		
40	Jefferson,	Punxsutawney,	J. Smith	51.21	68.22	54.97	84.50	37.00	58.13	12	.....	.....	..	28.92	28.92	28.92	29.20	28.60	28.92	12	.
41	Warren,																				
42	Venango,	Franklin,	Wm. Connely,	63.57	76.52	68.12	93.00	48.00	69.40	3⅓	.....	.....	..	29.09	29.08	29.07	29.26	28.56	29.08	3	.
43	Armstrong,																				
44	Westmoreland,																				
45	Fayette,	Uniontown,	J. P. Weethee,	63.23	77.67	64.27	92.00	42.00	68.39	.	.....	.....	..	29.02	29.02	29.02	29.27	28.75	29.02	.	23⅓
46	Green,																				
47	Washington,																				
48	Alleghany,	Pittsburgh,	J. P. Bakewell,	67.27	71.55	69.65	86.00	56.00	69.49	1⅓	46.00	59.10	..	29.26	29.23	29.22	29.52	28.96	29.24	1⅓	9⅔
49	Beaver,	Beaver,	James Allison,																		
50	Butler,	Butler,	Jacob Mechling,	62.47	75.87	68.53	87.00	45.00	68.96	.	.....	.....	..	28.72	28.75	28.71	29.51	28.10	28.73	.	.
51	Mercer,																				
52	Crawford,	Meadville,	Henry Shippen,	58.53	75.87	61.40	90.00	42.00	65.27	.	38.00	55.77	..	28.78	28.77	28.77	29.05	28.49	28.77	.	9
53	Erie,	Erie,	James C. Reid,																		

er.					Barometer.							Weather.							
	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
54	8	40.00	56.87	7	30.12	30.08	30.04	30.34	29.72	30.08	6	19	5	6	7	.....	.....	3	1.828
35	⅔	46.50	56.18	..	30.03	30.00	30.03	30.31	29.62	30.02	⅔	17	12	1	6	.....	.....	..	1.948
02	20⅓	.....	.....	..	29.54	29.52	.....	29.80	29.20	29.53	20⅓	1⅓	9	19⅔	.....	.....	.....	..	3.160
58	.	47.00	54.53	..	27.72	27.72	27.73	28.31	27.05	27.72	.	11⅔	18⅓	.	8	.....	.....	..	2.990
52	2⅔	.....	.....	..	29.34	29.37	29.35	29.60	29.00	29.36	2⅔	9⅔	17⅓	3	6	.....	.....	..	2.762
74	17⅓	60.00	64.55	19	29.52	29.48	29.49	29.73	29.22	29.50	18	.	.	.	.....	.....	.....	..	.....
71	⅓	48.00	59·93	..	29.53	29.50	29·52	29.80	29.14	29.52	⅓	16⅓	13⅓	⅓	6	.....	.....	1	2.200
27	.	54.00	61.90	..	29.73	29.71	29.72	30.02	29.45	29.72	.	.	.	.	....	.....	.....	..	1.775
31	.	42.00	54.18	..	29.49	29.47	29.48	29.79	29.10	29.48	.	10⅔	19	⅓	7	.....	.....	2	2.903
29	1⅓	.....	.....	..	29.48	29.44	29.46	29.78	29.11	29.46	1⅓	11⅔	16⅓	2	3	.....	.....	..	1.620
75	½	45.00	57.33	..	29.42	29.39	29.39	29.63	29.11	29.40	.	17⅔	12⅓	.	3	...	.....	2	4.146
21	⅔	.....	.....	..	29.38	29.36	29.37	29.66	29.08	29.37	⅔	20	10	.	8	.....	.....	..	3.873
62	2	.....	.....	..	29.32	29.29	29.28	29.60	29.01	29.30	2	14⅓	11⅔	4	3	.....	.....	1	3.105
42	3⅓	40.00	52.50	2	27.88	27.88	27.84	28.11	27.58	27.87	3	8⅓	18	3⅔	6	. ...	.....	1	3.463
75	.	.....	.....	..	29.27	29.26	29.25	29.50	28.95	29.26	.	17⅔	12⅓	.	.....	.....	.....	..	.....
83	9	40.50	50.19	9	27.84	27.85	27.83	28.09	27.60	27.84	9	9⅔	12⅔	7⅓	6	.....	.....	1	3.380
13	12	.....	.....	..	28.92	28.92	28.92	29.20	28.60	28.92	12	.	.	.	.....	.....	.....	..	.....
40	3⅓	.....	.....	..	29.09	29.08	29.07	29.26	28.56	29.08	3	.	.	.	.....	.....	.....	..	1.510
39	.	.....	.....	..	29.02	29.02	29.02	29.27	28.75	29.02	.	23⅓	6⅔	.	.....	.....	.....	..	.....
49	1⅓	46.00	59.10	..	29.26	29.23	29.22	29.52	28.96	29.24	1⅓	9⅔	19	1⅓	6	.....	.....	..	1.571
96	.	.....	.....	..	28.72	28.75	28.71	29.51	28.10	28.73	.	.	.	.	4	.....	.....	..	1.400
27	.	38.00	55.77	..	28.78	28.77	28.77	29.05	28.49	28.77	.	9	21	.	8	.....	.....	..	2.216

Thunder Showers.	Rain in inches.	Winds.																	Hygrometer.					No. of Report.
		North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	
3	1.828	3⅔	⅓	5⅔	⅔	2⅓	.	1	⅓	3	.	1	⅓	1	.	1⅓	1	.	8⅓	....	.	.....	....	..	1741
..	1.948	1⅓	⅓	5⅔	1⅔	1	2⅓	3	⅓	1	⅓	3⅔	.	⅓	⅔	7	⅔	.	⅔	....	.	.....	....	..	1583
..	3.160	1⅓	.	⅓	.	3⅔	.	.	.	1⅓	.	3	.	3⅓	.	⅔	.	.	16⅓	....	.	.....	....	..	1650
..	2.990	.	.	.	.	.	.	.	.	5⅓	.	9⅓	.	9⅓	.	6	.	.	.	....	.	.....	....	..	1623
..	2.762	⅓	.	2	3	3	⅓	⅔	.	1⅓	.	⅔	⅓	2	.	2⅓	.	11⅓	2⅔	....	.	.....	....	..	1598
..	.....	3	⅓	⅔	⅔	⅔	.	.	.	1	⅓	1⅓	⅓	1	⅔	1	⅓	1⅓	17	....	.	.....	....	..	1600
1	2.200	2⅔	2⅓	2⅓	.	3	.	1⅓	3⅔	3⅔	2⅓	1	.	1⅓	.	1	4⅔	.	⅓	62.48	1	.....	66.72	1	1595
..	1.775	1	.	.	.	7⅔	.	6⅓	.	.	.	5	.	6⅓	.	3⅔	.	.	.	....	.	.....	....	..	1580
2	2.903	3⅔	.	3	.	2⅓	.	1	⅔	7⅔	.	⅔	.	4⅓	.	1	.	5	⅔	....	.	.....	66.10	..	1582
..	1.620	.	.	.	.	⅓	.	5⅔	.	.	.	1⅔	.	⅔	.	4	.	16⅓	1⅓	....	.	.....	....	..	1581
2	4.146	3	2⅔	1	.	1	.	2⅔	⅔	5⅔	2	2⅓	⅔	1	⅓	2	1⅓	3⅔	.	59.33	1	.....	64.62	1	1653
..	3.873	.	.	.	.	10⅔	.	.	.	.	.	.	.	18⅔	.	.	.	.	⅔	....	.	.....	....	..	1601
1	3.105	5⅓	⅓	2⅓	.	1⅓	⅓	3	1	2⅔	.	1⅔	⅔	1	1⅓	⅔	⅔	1	6⅔	....	.	.....	....	..	1596
1	3.463	⅔	.	1⅔	.	1⅔	.	4	.	1⅔	.	2	.	6⅔	.	3	.	5⅔	3	....	.	.....	....	..	1594
..	.....	⅓	⅓	⅓	.	1	.	2⅓	5	2	⅓	3⅔	2	2⅔	8	2	.	.	.	....	.	.. .	....	..	1584
1	3.380	.	.	.	.	.	.	⅓	⅓	1⅔	⅓	4	⅔	3⅓	1	⅔	.	8⅔	9	....	.	.....	67.64	12	1620
..	.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	.....	....	..	1625
..	1.510	.	.	.	.	.	.	3⅔	.	.	.	2⅓	.	.	.	19⅓	.	.	4⅔	....	.	.....	....	..	1597
..	.....	⅔	.	⅔	.	⅔	.	3⅔	.	.	.	13⅔	.	4⅓	.	2⅔	.	4	.	....	.	.....	....	..	1608
..	1.571	.	.	⅓	.	⅓	⅔	5⅔	⅔	1⅓	⅔	1⅓	.	⅓	.	4⅔	⅓	11⅓	2⅓	....	.	.....	....	..	1593
..	1.400	.	.	.	.	11⅔	.	⅓	.	.	.	⅓	.	16	.	1⅔	.	.	.	....	.	.....	....	..	1592
..	2.216	3	.	⅔	.	3	.	1⅓	.	4⅓	.	⅓	⅓	1	.	1⅔	.	13⅔	⅔	....	.	.....	....	..	1591

JOURNAL

OF

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OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

OCTOBER, 1841.

Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[continued from page 154.]

Terrestrial Geomorphy.—General Principles, Stations and Signals.

109. To determine the relative position of the most prominent points of an extensive district of country, such as a province or kingdom, the most elevated points are selected commanding an extensive view of the surrounding country. From these places, called *stations*, the observations are made. When necessary, sheds are constructed at them, and *signals* which can be seen from the neighboring stations. To economize time, trouble and expense, and to attain greater precision, the stations should be as far apart as possible (usually 8 or 10 thousand metres, or 5 or 6 miles.) The stations joined by imaginary lines constitute a plexus formed of a series of large triangles, covering the entire country to be surveyed. All the elements of these triangles are either measured or calculated.

The engineer measures with extreme care all the angles of these triangles, and a distance called the *base*. This base is one of the sides of some one of the series of triangles. The lengths of all the other sides are found by calculation. This plexus is called a *canevas trigonometrique*.

These various triangles are, it is true, situated in space, and form a polyhedron with triangular faces enveloping the ground. But, if a perpendicular line is let fall from each summit, it meets a point under ground on the level of the surface of the sea. This surface is considered in geodesy that of the terrestrial spheroid, because the inequalities

of the mountains compared with the immense magnitude of the globe become insignificant and may be neglected. Thus we substitute for right lined triangles determined by observation, curvelinear triangles obtained by calculation. The projection of the observed triangles on the terrestrial spheroid is called *reducing them to the horizon.* As the figure of the spheroid differs very little from that of a sphere, each of these projections is assumed to be made on a sphere of a certain radius, regard being had to the smallness of each triangle. This radius varies with the place.

The largest triangles in the plexus are called *triangles of the first order.* When they are established, other stations within them are selected, and connected with them by observations made with great care, though not with as much as the observations made for the primitive triangles. The triangles of the second order, smaller than those of the first, are thus established.

These in their turn are made use of to form the *triangles of the third order.* When their sides do not exceed six hundred or a thousand metres (656 or 1095 yards) in length, the curvature is so little appreciable that they may be regarded as right lines. These lengths serve to determine positions in detail, and complete the topography. Thus geomorphy embraces the exact determination of the triangles of the first, second and third orders, and their projection upon the terrestrial spheroid.

110. It is also proposed to show under this head the manner of finding the length of an arc of the meridian traversing a plexus. It is evident that this length cannot be measured satisfactorily. The operation of measuring a base of 6 or 7 miles, on even ground is extremely difficult, how much more so then would it become to measure a large terrestrial arc traversing hills, mountains, and other obstacles. It can only be attained by calculating the arc in parts as will be explained.

The terrestrial meridian which traverses France, from Dunkirk to Barcelona was obtained in this manner; the arc has since been produced beyond these limits. Arcs perpendicular to this meridian have also been determined. By these operations, the figure and dimensions of the terrestrial spheroid, the length of the metre, &c., have been ascertained.

The *longitude* and *latitude* of each station, and the *azimuth* of each side of the triangle is also necessary to be known. Astronomical observations furnish these elements for some of these stations, and calculation gives them for others.

The elevation of each station above the surrounding ground, and

above the terrestrial spheroid is called the *altitude*, and is ascertained by leveling.

These are the subjects it is proposed to treat in geomorphy.

111. We will now examine the best manner of placing the stations with regard to each other to insure correct results.

Let a b c (fig. 32 see plate II., vol. 1,) be the sides of any triangle, and A B C the angles respectively opposite to them,

we have $a \sin. B = b \sin. A.$ . . . . (1)

This equation gives the side a when we know A, B, and b. Now if any little error has been committed in the measurement of these angles, for example an error at A equal to y, and one at B equal to y', b being supposed correct, instead of using the values A and B, we use the erroneous ones $A + y$ and $B + y'$. This will make an error in the value of x expressed by b; and equat. (1) becomes

$$(a + x) \sin. (B + y') = b \sin. (A + y).$$

Develope these sines, and as y and y' are always very small, substitute their arcs for their sines, and 1 for their cosines; it will then become

$$(a + x) (\sin. B + y) \cos. B) = b (\sin. A + y \cos. A).$$

Reduce this by the aid of equation (1) and suppress the product $x\,y'$ cos. B, and we have

$$x \sin. B + a\,y' \cos. B = b\,y \cos. A,$$

and by placing $\frac{a \sin. B}{\sin. A}$ for b, we have

$$x = a (y \cos. A - y' \cos. B).$$

This then is the error in the sine a produced by the errors of obsertion y and y' at the angles A and B.

It is evident that x is small in proportion as A and B approach equality, supposing y and y' equal; and the error is nothing when y and y' are equal and of the same algebraic sign and A = B. In this case the side a is given correctly by calculation, although erroneous observations have been used. If the errors y and y' are equal and of contrary signs, the equation becomes $x = a\,y$ (cos. A + cos. B), which the condition A = B makes a *minimum*.

We have $x = a\,y \left(\frac{\cos. A}{\sin. A} + \frac{\cos. B}{\sin. B}\right) = a\,y \frac{\sin. (A + B)}{\sin. A \sin. B}$

and by substituting $\frac{\cos. (A—B) + \cos. C}{2}$ for sin. A sin. B. (See trigonometry.)

we have $x = a\,y \frac{2 \sin. C}{\cos. (A—B) + \cos. C}$, an expression which has evidently the smallest possible value when A = B.

We see then, that for the purpose of reducing the error, it is most favourable under any circumstances that the triangle should be *equilateral. When the sides sought are each equal to the measured side,* it may be regarded as certain, *that the error of the angles is insensible.* But, as it is frequently impossible to have the triangle equilateral, we are satisfied with approaching this condition by never admitting an angle of a triangle less than 30°. We say then that *the triangle is well adapted.* The stations should be chosen to conform to this principle as nearly as possible.

112. Suppose now that the side b is not of the proper length, but that the angles A and B are correct. The true value of b will be replaced by $b + z$, and a by $a + x$; z and x being the errors;

$$\text{then } (a + x) \sin. B = (b + z) \sin A,$$

$$\text{and } x \sin. B = z \sin. A;\ x = z \frac{\sin. A}{\sin. B}$$

Thus the smaller the angle B is, the greater will be the effect of the error z on the opposite side a. When B = 30°, the smallest limit allowed, we have sin. B = ½, $x = 2z$ sin. A. But then A + C = 150°, and each of the angles A and B should be nearly 75°; the sin. A then differs little from 1, and x from 2 z. Thus the error z committed on the side b is carried to the side a and doubled. In this manner the error increases from one triangle to another until in the end it is very great.

We conclude therefore that in a triangle well adapted, a small error committed in measuring the length of one of the sides, is much more mischievous than an error made in the measurement of the angles, because in the first, under favourable circumstances, it increases, and may even become doubled in calculating the other sides, while errors from the angles do not necessarily alter the value of the sides deduced from them. It is evident then that the base must be measured with extreme precaution, or the errors will accumulate from one triangle to the other.

113. It is almost impossible to measure the base with absolute accuracy. It is very short compared to the extent of country to be plotted, and is one of the sides of the first triangle, which is connected with a second, and this last with a third, and so on, each triangle increasing a little. When they are nearly equilateral, the accumulation of error is avoided and the results may be relied on. But when the operation is finished it is necessary to test its accuracy. This is done by measuring another base, far away from the first, and forming one of the sides of a triangle. If the triangulation is exact the measured length of the side of the triangle will correspond to the length obtained by calculation.

The longitudes and latitudes of the stations and the azimuths of the sides of the triangles form another means of verifying the accuracy of the triangulation. These angular values being determined at one station by astronomical observations, we find what they are at another station by calculating the position of the intervening stations in succession. The astronomical observations are repeated at the station to be verified, and a comparison of them with the calculated position of the station indicates the errors if any, and the compensation to be made for them, without, however, invalidating operations absolutely correct.

Laplace has demonstrated, that it is better to use as few triangles of the first order as possible; and that they should be of as large dimensions as the localities and the power of the telescopes admit.

114. The *signals* should be established in such a manner as to be seen with distinctness a great distance. Vertical stakes and reversed cones are excellent for this purpose. Steeples, spires, towers, &c., should only be used when the observer can place himself at them to observe with facility and especially with stability; and care should always be taken to project the axis of the signal on the ground so as to leave no uncertainty of its position. Trees without branches, and mills, may be used for triangles of the third order, because the errors resulting from them are not propagated.

The best signal is a circular iron plate with a hole in the centre. It should be fitted to a vertical rod, around which it revolves, so as to present its face to the neighbouring stations in succession.

A small quadrangular pyramid stuck on the top of a staff is also frequently used as a signal.

It was thought that Bengal fire and reverberating parabolic reflectors would be useful for nocturnal observations, as a means of employing time in foggy weather. But it has been abandoned; the horizon is never sufficiently clear at night, and terrestrial refractions increase the causes of uncertainty.

115. A signal can be seen better when projected on the sky than on the ground or the trees. Then, being stationed at A (fig. 57) it is easy to ascertain if the signal there will be seen from B, projected against the sky without going to B. For example take the zenith distance of B and that of the mountain C directly opposite, that is the angles B A Z, C A Z; the point C falls above or below the direction A B I according as the sum of these angles is greater or less than 180°. Thus we will elevate the signal A until B A Z + C A Z is greater than 180°.

All the signals projected against the sky should be painted black, and those against the ground or the forest white.

When no building can be had, which will answer the purpose both of a signal and a shelter to the engineer, it is frequently necessary to erect a temporary observatory. It is made in the form of a quadrangular pyramid truncated near the summit. (Fig. 64). A staff S in the axis serves as a signal, and the observer places his instrument at the point C, the horizontal projection of the axis. The pyramid is made of wood, and roofed to within about six feet of the ground. A cloth stretched on the windward side completes the shelter. When the observations are completed, the pyramid is removed, and a square monument firmly planted at C, with two diagonal lines drawn on it intersecting each other in the axis of the signal.

Subsequent verifications require these stations to be revisited, and the monuments thus fixed form indisputable evidence of their locality and are easy to find.

When a signal is erected, it should be sufficiently high to be seen from the neighbouring ones. It is ascertained by experiment that it should be seen at least under an angle of 31"; and as the tang. 31" = 0.00015, the height A B (fig. 56) of the signal being A B = A C tang. C = A C × 0.00015, we see that it is necessary that this height should be at least fifteen times the hundred thousandth of its distance from the observer. If this distance is the usual one which is about 20,000 metres (21,900 yards) the signal should be more than 3 metres (9.842 feet) high. In the French triangulation the signals were given an elevation of one seven thousandth of the distance they were to be seen.

117. It frequently happens that the signal A seen from stations B and C (fig. 65) is not a fit one to observe from. It is then necessary to place the instrument in its vicinity, for example at O, and measure the angle B O C = O, and then make the corrections to reduce it to the angle B A C = A, the angle that would have been obtained if the instrument had been stationed at A. This is called *reducing the angle to the centre of the station.* The three sides of the triangle A B C, which we call a, b, c, are supposed to be known, approximately at least.

We will first suppose the case of the triangle B A C where the point O is in the direction of the side B' A. Draw O E parallel to A C, and make A O = m, and the angle A C O = ϕ = C O E. The angle B' O C, is known, and it is required to find the angle A = $\alpha + \phi$. Then the triangle C A O gives

$$\frac{\text{sin. C}}{m} = \frac{\text{sin } \alpha}{\text{AC}} \text{ whence sin. C} = \text{sin } \vartheta = \frac{m \text{ sin. } \alpha}{b}$$

As m is always very small in relation to b, sin. ϑ is very small and

may be replaced by θ, or rather by $\theta \sin. 1''$, as θ expresses the number of seconds in the arc. Thus

$$A = a + \frac{m \sin. a}{b \sin. 1''}$$

Now if the triangle is A B C, where the station O is not in the direction of one of the sides of the triangle, we have

$$B' A C = a + \theta = a + \frac{m \sin. a}{b \sin. 1''}$$

$$B' A B = a' + \theta' = a' + \frac{m \sin. a'}{c \sin. 1''};$$

$$\text{then } A = O + \frac{m}{\sin. 1''}\left(\frac{c \sin. a + b \sin. a}{b c}\right) \quad . \quad . \quad . \quad (1)$$

In the application of this formula, it is necessary to bear in mind that when the station is so placed that either one of the angles θ, θ' falls on the other side of the line A C or A B, the angle then should be subtracted from O. Thus, the two expressions $c \sin. a$, $b \sin. a'$ are both positive, only when the station O is within the angle p A q formed by the prolongation of the sides of the triangle. When it is situated in the angle B A C they are both negative, and when O is placed in the angle C A q, or the angle B A p, as in figure 63, they are of contrary signs.

118. This last is the most favorable position for reducing the angle, and it sometimes happens that the two terms in equation (1) destroy each other and there is no correction to make. This takes place when $c \sin. a = b \sin. a'$ whence

$\frac{\sin. a}{\sin. a'} = \frac{b}{c}$; then we have $\frac{b}{c} = \frac{\sin. B}{\sin. C} = \frac{\sin. (A + C)}{\sin. C}$,

and $A = a - a'$; from which we find $a = A + a'$,

$$\frac{\sin. (A + c)}{\sin. c} = \frac{\sin. a}{\sin. a'} = \frac{\sin. (A + a')}{\sin. a'},$$

Developing this equation and making the reductions, we have

$$\frac{\sin. A \cos. C + \sin. C \cos. A}{\cos. C} = \frac{\sin. A \cos. a' + \sin. a' \cos. A}{\sin. a'}$$

whence $\cos. C = \cos. a'$.

Thus the observed angle O requires no correction to become A, whenever $C = a'$ or $180° + a'$. In this case the quadrilateral A B C O can be inscribed in a circle, because the angles B C A and B O A have the same measure in the circle circumscribing the triangle A B C. The station O can then be chosen so as to fulfil this condition.

119. But it is seldom this case presents itself, and in all others the angle O must be reduced by equation (1). This equation is adapted

to the use of logarithms in the following manner: The triangle A B gives

$$\frac{b}{c} = \frac{\sin.\ (A + C)}{\sin.\ C};$$

and $O = a' + a$ may be regarded as equal to A; thus $a = A - a'$. By substituting these values in equation (1) it becomes

$$A = O + \frac{m}{b \sin. 1''}\left[\sin.(A - a' + \frac{\sin.(A + C)\sin. a'}{\sin. C}\right]$$

Reducing this expression to the same denomination, &c., it becomes,

$$A = O + \frac{m \sin. A \sin.(C + a')}{b \sin. C \sin. 1''} \quad . \ . \ . \ . \ . \ (2)$$

This expresses *in seconds* the correction to be made in the angle B O C to make it equal to B A C.

120. When the signal is in the axis of a cylinder, the centre A cannot be seen from O. It is then determined by drawing lines tangent to each side of the cylinder, and bisecting the angle. Thus we measure the angles B O *l'*, B O *l* (fig. 70) and the mean between them is the angle B O *k'* = *a*.

In getting the distance O A = *m*, if we cannot measure directly the radius A *k* = *r*, we measure O *k* = *i* = *m* — *r*, and also one of the tangents O *l* = *t* = O *l'*, we will then have

$$O\,l^2 = O\,A^2 - A\,l^2 \text{ or } t^2 = m^2 - r^2 = (m + r)\,i.$$

This equation gives $m + r = \frac{t^2}{i}$; and as $m - r = i$, by adding these equations we get $2m = i + \frac{t^2}{i}$,

It may be proper to observe that, as the terms containing *a* and *m* express very small quantities, it is not necessary to have their values very exactly; moreover, as the use of the above problem does not suppose great accuracy, we are authorized in taking A = O.

[TO BE CONTINUED.]

Notes on Belgium. By CAPTAIN G. W. HUGHES, *United States Topographical Engineer. Addressed to* FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington, D. C.*

[CONTINUED FROM PAGE 164.]

Steam engines are made at Liege, Serainge, Brussels, Molenbeck, Gilly, Tirlemant, Bruges, and Namur. From 1829 to 1835, there were 261 steam engines of 5,400 horses power, built at Liege, since which time the numbers and power have nearly tripled.

Nail making is also a very important branch of industry connected with the mineral productions of this country. The principal factories

are at Liege and Charleroi, at which latter place there are 5,500 workmen constantly employed.

The reputation of the arms fabricated in Belgium is now well established. The principal seat of this branch of industry is at Liege, which numbers, within its jurisdiction, more than fifty manufactories, and most of them in a highly flourishing condition. These products are exported to South America, Egypt, Turkey, Germany, Italy, Spain, and even the United States, where, it is said, they are preferred to the Birmingham arms. Be this as it may, it is a well known fact that gun and pistol barrels, and locks, are sent to England, where they are mounted and *marked*, and sold for *three times* the Belgian prices; but this is owing somewhat to the superior style in which they are finished in England. It is estimated that more than 30,000 stand of arms are annually exported to the Brazils. The following table shows the amount of this species of manufacture for 1836, (the last official statement I have been able to procure,) since which time it has *greatly* increased, and perhaps nearly doubled.*

Sporting guns, (single barrel,) - - -	152,044
" " (double barrel,) - - -	24,846
Boarding muskets, (for ships,) - -	8,438
Holster pistols, per pair, (for Cavalry,) - -	22,086
Pocket pistols, per pair, - - -	70,314
Muskets for Infantry of the Line, - -	71,651
Total of all kinds, - -	349,379
Estimated to be worth -	$ 1,400,000

I have no where seen rifles, (*un fusil rayé*,) mentioned in the returns of arms; yet almost all their *case* pistols are rifled, but so far as I can learn, the American rifle is not much used, and its fearful and deadly qualities, as an offensive weapon, not well understood. The Belgian officers have been not a little astonished (and somewhat incredulous I have thought,) at the accounts I have related of the feats with this arm of some of our Western back woodsmen.

The country embraced between the French frontier and an imaginary line drawn from Ostende to Arlon, comprising the Province of Liege, abounds with building materials, such as marbles, of different kinds, granite, slate, freestone, and lime, of different qualities, including the *hydraulic*, which is much used as a stucco for the exterior covering of houses.

The provinces of Hainault, Namur, Liege, and Luxembourg, con-

* There are more arms manufactured in Liege alone, than in the whole of France; and it even exceeds, in this respect, Birmingham, which is regarded as the great armory of England.

tain many *marble* quarries; the most important of which are in the cantons of Beaumont and Chimai, near Fontaine l'Eveque, Bouvigne, near Rochefort, at Dinaut, St. Medard, and Lesves—the neighbourhood of Phillipeville presents many varieties of them; the black marble of Dinaut is particularly recherché.

The best and most beautiful *slates* (perfectly free from iron pyrites,) are found in the provinces of Namur and Luxemburg. The quarries of Herbeumont are the most important, and yield over 8,000,000 per annum. They sell at the quarry, when well dressed, for about $3 per thousand.

Excellent building stones, and lime stones, occur in the provinces of Namur, Luxemburg, Liege, Limburg, Hainaut, and Brabant. The blue lime stones (les pierres bleues,) found in the vicinity of Dinaut, and at Soignies, are much esteemed.

The most beautiful building stone in Belgium, is the blue carbonate of lime, already mentioned as the pierre bleue, of a fine and compact grain. It is easily cut, and is susceptible of a good polish. It resists the action of air, water, and frost; and is quarried in large blocks, sometimes sufficiently massive to make columns of a single piece, from twenty to twenty-five feet in height. The better kinds of this rock are in much demand throughout the kingdom, and much of it is transported to Holland. It is used in Brussels for the basements, pillars, stair-ways, lintels, and cornices of houses, and for the trottoir of streets, etc. The other portions of the structure are usually built of either bricks, or of a whitish brown free stone, called grés, found in the neighbourhood. It is rather soft when first quarried, cuts easily, and indurates on exposure to the atmosphere. This stone is usually worked in small regular pieces, and when well dressed, forms a handsome façade. The beautiful metropolitan church of St. Gudule, and the celebrated Hotel de ville de Bruxelles, are both being restored with this material; and the partial restoration of the lofty, rich, and towering spire of the latter is already very agreeable to the eye, and cannot fail to produce, when completely finished, a most striking effect. It is highly creditable to the Belgians that, since the revolution, which gave them for the first time since the days of Cæsar, a separate and distinct rank amongst the nations of the earth, the work of restoring the ancient architectural monuments of the country has been carried forward in a spirit of patriotism, liberality, and good taste. This stone, le grés, unites quickly and strongly with mortar; and the pierre bleue is occasionally used as a hydraulic cement.

The blue lime stone of Nivelle, although of the same sub-species with the foregoing, is inferior to it in quality.

This same kind of rock is also found on the banks of the Meuse,

between Namur and Huy; but it cracks and scales off more readily than the Soignes stone, and, when quarried in the winter, does not well resist the action of frost.

The lime obtained from this stone, mixed in equal proportions with sand, and a little hair, constitutes the usual stucco used in Brussels, where *every house*, except those built exclusively of stone, is covered by it. This cement certainly resists the action of the atmosphere most admirably; and the universal practice of plastering the houses, or white-washing them, gives to "Belgium's ancient capital" an air of neatness and lightness but seldom seen in European towns. The best composition for this purpose is a mixture of the cendrie de Tournay and sand, and occasionally a small proportion of common lime. The Tournay cinders are a powder formed by half burning a hard blue limestone, found at Tournay, the debris of which falls through the furnace grates, and is mixed with the (mineral,) coal ashes. This is said to be quite equal to the *Dutch Terrasse*, and is employed for the same purposes. And indeed the Terrasse of Holland, the cinders of Tournay, and the powder of well baked earthen tiles, may be regarded as artificial Puzzolanas, which acquire by heat, the property of solidifying under water.

The *Terrasse de Hollande* is a species of argillaceous earth found near Cologne. It forms, when baked, ground to a powder, and mixed with common lime, a capital cement, which alike resists humidity, dryness, and the extremes of temperature.

Besides the afore-mentioned substance, there is another much used in Holland, and in some parts of Belgium, called Trass, which is a species of lava, and is undoubtedly of volcanic origin. It is divided into two classes; the first is the soft stone of Andernock, (le moellon d'Andernock,) quite fragile, and of a whitish gray colour; the second is known as le moellon de Boul, harder than the first, and of a deeper gray colour, yielding, when ground, a kind of puzzolana which produces, when mixed with an equal quantity of fat lime, a very indurated morter, perfectly impervious to water. The hardest of these moellons are selected for the most important hydraulic purposes, such as dykes and subterranean structures, where it is necessary to prevent the infiltration of water. For ordinary works, the two kinds of powder are mixed in equal proportions, and this forms the article generally known in commerce as "*Andernock*," which is the name of the town where it is found, not far below the junction of the Mozelle with the Rhine. This material is much used for building in the towns on the Rhine and its tributaries.

For the exterior covering of the walls of buildings, the hydraulic

lime of Tournay is commonly used in Brussels, and the mortar is generally composed of the following constituents.

1st. One cubic yard of lime, in paste.

2nd. One and a half cubic yards of sharp sand.

3rd. Fifty pounds of short hair, as it is scraped from hides in dressing them.

These three substances should be well mixed and ground together, and no more water added than may be necessary, to render the mortar tolerably thick and pulpy.

The sand is employed in the condition in which it is taken from the pits, except that it is passed through a rather fine wire seive, to get rid of the small stones, or coarse gravel.

The stucco usually consists of three coats, or layers, each layer being about five millimetres, or a little less than two-tenths of an inch thick; making the whole thickness of the plastering about one-half inch.

After having wet the walls, in order that the mortar may the more readily adhere, the first coat is quickly applied with a trowel. This first layer is called *cripis*, because it produces an extremely rough surface. When the cripis has been perfectly dried, the second coating is laid on, and should be well dressed and smoothed with a ruler, or straight piece of board; and when the cement has acquired a certain consistency, the third and last layer is applied, and carefully dressed and trimmed with a trowel.

The cost of this kind of composition, including materials and labour, is, per square yard, sixty centimes, or about 11½ cents.

The interior walls of houses are plastered in the same manner, and with the same kind of cement, except that *walloon lime* and *fine sand* are employed; and as this lime is much fatter than the hydraulic lime it neutralizes a greater quantity of sand. A mixture of one cubic yard of lime with two cubic yards of fine sand makes an excellent mortar. The price per square yard, of this kind of work, everything included, is fifty-five centimes, or about 10½ cents of our money.

The price of a cubic yard of Tournay hydraulic lime, in Brussels, is about - - - - - - $ 4,00

" of Tournay cinders, per cubic yard, 4,50

" of Walloon lime, - - - - 5,25

" of the pierre bleue, when well cut and chissel dressed, per cubic yard, - 20,00

To which must be added per square yard of surface, cut to mouldings, - - - 4,12½

I deeply regret not having been able to procure the analyses of their various building substances, but it is extremely difficult to ac-

quire information of this kind in Belgium; and indeed the analyses of minerals would seem not to have excited much interest among the savans of this country.

Mill-stones, grind-stones, flints, and whet-stones, have been long known in Luxemburg and Liége; the grind-stones quarried at Nil-salm are among the very best in Europe, and there are about 80,000 of these stones, some of very large size, dressed each year for market; and many of them are sent abroad.

The province of Namur furnishes a very good kind of clay, adapted to the manufactory of Delft ware, potter's ware, and pipes. There is also a very considerable sand bank in Ardennes, which produces an excellent metal for porcelain.

Our Minister to Brussels, Mr. Maxcy, having procured general letters to the industrial establishments of this country, from Mr. Mieus, (a Director of the *Societé Generale*, the great Bank of Belgium, which is connected with nearly all of the large manufactories of the kingdom,) I recently, in company with that gentleman, made an excursion to Charleroi, an important frontier town on the Sambre, for the purpose of examining the productive works of that rich mineral and manufacturing district.

It may be proper to remark that a good deal of caution is observed in admitting strangers to visit manufactories in Europe; and indeed without an order from an officer, or from some person connected with those establishments, it is difficult, if not impossible, to gain access to them; and letters of introduction, for such purposes, are not easily obtained.

We first went to the iron works of Couillet, near Charleroi. They belong to a chartered company called "*la Societé anonyme* de Couillet pour la fabrication de fer." Almost all the works of this kind are joint stock concerns, and when so are usually designated as the Anonymous Society of a certain place, for a specific purpose; and these companies are placed under the *patronage* (as it is called,) of some great Banking Institution, through the agency of which they transact their financial business. The *Observateur*, a Brussels newspaper, has recently published "a table of the different administrations confided to Count Mieus, (Governor of the *Societé Generale*,) the funds of which represent a capital of 233,520,100 francs;" this capital is divided among seventeen financial and industrial Societies.

The iron works of Couillet are truly magnificent, covering more than eleven acres of ground. All the structures are well built, and exhibit a good deal of taste, as well as skill, in their designs.

This establishment contains eight blast furnaces, (hauts fourneaux,) only one of which is at present in activity; and at no time have there

been more than five in operation, owing to the falling off of the iron trade since 1837, (the most of the furnaces having been erected subsequently to that year,) which would have proved still more embarrassing to the iron masters, but for the demands of the government for railway purposes; which were, to a certain extent, anticipated, for succeeding years, in order to lessen the check to this branch of industry. There are twenty-two blast furnaces in the immediate vicinity of Charleroi, but the half of them are not in use at present.

The furnaces at Couillet are forty-five feet high, and fifteen feet across the boshes. The blast is usually hot, and it requires an engine of sixty horses power to work one furnace. With the hot blast the following is the charge.

Ore, - - - -	40 buckets.
Coke, - - -	34 "
Lime-stone, - - -	24 "

With the cold blast the ore is diminished to thirty buckets, while the other substances remain constant.

The materials for the charge are elevated by buckets attached to an endless chain, which passes over two drums, the one at the top, and the other at the foot of the stack, between the two furnaces, and is moved by the steam engine which keeps up the blast. Each furnace yields from ten to twelve tons of pig metal per day. The hearths are built of fire brick, (made at the works,) and last from five to eight years. The coal is found close at hand, but cannot be used to advantage for reducing ores, until coked, which process is here conducted in ovens, of which there are a great number.

In Wales the coking is usually done in the open air, very much in the way wood is carbonized in the United States, by covering it with earth; but this is a wasteful mode of operation. The coal about Couillet yields from sixty to seventy per cent. of coke—the first for the refineries and the second for the blasts. The deepest coal pits in this district are from 900 to 1200 feet below the surface. The best coal is taken from a bed four and a half feet thick. They find but little iron ore with the coal, and those used are the limonites, brought from a distance of three or four miles, and yield from thirty-five to forty-five per cent. of metal. Sulphuret of lead is sometimes found in considerable quantities with the iron ore.

The rolling mills and forges are very extensive, and embrace the latest and most approved English and German improvements.

An engine of sixteen horses power moves two immense trip hammers at the same time; they are kept in motion by a large revolving cylinder with cogs; and as these cogs trip the hammers, they fall on

the heated metal below. With these hammers they have forged masses of metal weighing 4000 lbs. The best metal is made in this way, and is not rolled, except once, when taken from the puddling furnaces. When very strong iron is required, several bars are heated, and welded together, by these ponderous hammers; the *best* quality of iron brings, at this time, 400 francs per 1000 kilogrammes, or about $80 per ton. With the hammers are connected two enormous pairs of shears, which seem to meet with scarcely any resistance in cutting through rods of iron of two and a half inches diameter.

We went next to the machine shop for the fabrication of steam engines, screws, tools, &c., used for turning and planing castings. We here noticed a large mortising machine (for cutting mortises out of cast iron,) made by Sharp, Roberts & Co., of Manchester. An engine of twenty horses power is connected with this shop. It is proper to remark that all the steam engines employed in these works were made here. They are of the English form, and perform well. It is but just to the Belgium manufacturers to say, that whatever they *do* they do *faithfully;* in illustration of which I will mention that the minister of public works, in his report for 1840, states that not a single accident, producing any serious personal injury, occurred during that year, amongst the numerous steam engines in constant use; of which, I think he said, there were between 11 and 1200.

The foundry is also extensive, and the arrangements are adapted to the casting of very large pieces. The day of our visit they cast an iron plate for the Oignies glass works, of the following dimensions: 18 feet × 10 feet × 0.5 feet. It is quite difficult to cast so large a plate smoothly, and without flaws, and the first effort is seldom successful. The *form*, or *mould*, is prepared with bricks carefully laid, and then covered with a composition of sand, clay, and coke, hard rammed, and made as smooth as possible. The melted metal is run from the furnace into iron pots, connected with cranes, by which they are moved. When full, these pots weigh 1200 lbs., and are easily manœuvred by one man. It is essential to the success of the operation that the melted iron should be poured into the mould *precisely* at the very same time from all the pots, and from, at least, four different directions, else the several currents of metal will not perfectly unite. Another necessary precaution to be observed, is to guard against the danger of an explosion of the steam beneath the form, generated from the moisture, which it is found impossible completely to expel. To remove this difficulty, iron pipes, to carry off the vapour, are laid, in an inclined position, with one orifice under the mould, and the other exposed to the air. As soon as the plate becomes solid it is covered with sand, and left to cool slowly, which takes five or six days. It

is then planed quite smooth before it can be used for its destined purpose, the casting of large plate glass for mirrors.

In the rolling mills are two steam engines, respectively of sixty and eighty horses power. They were rolling arched rails for a Siberian railway, while we were present, of forty-four pounds to the yard. The iron, after being refined, is puddled, rolled, welded, and rolled four times, before it is carried to the pattern roller, and passed seven times through them before the process is completed. The railway chairs which we saw cast weigh eighteen pounds each.

There are 450 men employed in these works, exclusive of those engaged in the mines, and in transporting the raw materials. Some of the work is paid for in proportion to the quantity, but most of the workmen are hired by the day, their wages varying from two to three francs.

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Cost of Excavating Earth, by Means of Scrapers, or Scoops.

By ELLWOOD MORRIS, *Civil Engineer.*

Of all machines known to American Engineers, and used upon our public works for the excavation of earth, and its removal to short distances, the *scraper, or scoop*, is, within its proper sphere of influence, by far the most economical.

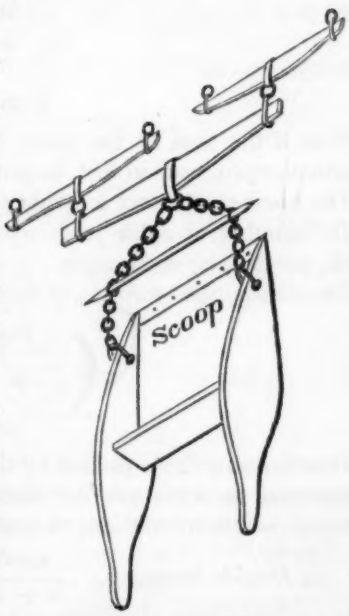
This instrument is particularly well known to Canal Contractors, much used by them in earth cuttings, and most frequently employed in excavating the trunks of canals, where they are so laid out that the cutting makes the bank, or nearly so; but the *scoop* may be used with success in all excavations of earth where the slopes do not exceed 1½ to 1, if the material to be taken out yields readily to the plough, and is not required to be moved horizontally more than 100 feet, nor to vertical heights exceeding 15 feet; there are doubtless instances where both these limits may be surpassed, and the use of the *scoop* still be highly economical, but such cases are not general, and the practical scope of the utility of *scoops* may be regarded as confined to the excavation of canal trunks, and the formation of low road embankments from side trenches, for both of which purposes it is most admirably adapted.

This machine is drawn by two horses, managed by a boy, and usually requires the ground to be first ploughed; then by simply elevating and guiding the handles a little, the driver causes it to load itself, for the horses being in motion it turns in its clevisses, and inclining downward, runs under the loose dirt like a plough; the handles being released, the loaded *scoop* moves upon two iron shod runners

which form the sides, and project below the bottom, and finally after reaching the place of deposit, the handles being smartly elevated, the edge of the *scoop*, which is armed with iron, takes hold of the bank, and the horses moving on, it overturns and discharges its load; in this overturned position, with the handles resting on the double tree, it returns upside down to the place of excavation, and is there loaded, &c., as before.

Although for successful scooping the ground usually requires loosening, and must not be so hard as to resist the plough; it is often the case, especially in sandy material, that it is so soft that the scoop, by its armed edge, is able to excavate it, and load itself, without any previous loosening of the earth.

All this will be rendered so evident to the reader, by an inspection of the annexed isometrical sketch, showing *a scoop*, with its double tree, and single trees, that any further description of the mode of operation seems to be entirely unnecessary.



The writer pursuing his object of acquiring, from actual experiment, a knowledge of the cost of excavating materials and forming embankments upon public works, early addressed himself to observe the effect produced by scoops, and the results of numerous observations upon scooping earth to horizontal distances of from 30 to 80 feet, and heights of 5 to 15 feet, where the slopes are 2 feet base to 1 foot rise, established in a satisfactory manner the following data:

1. That taking average earth (yielding readily to the plough,) at mean stages of weather and seasons, *a scoop load* may be taken at *one tenth of a cubic yard measured in excavation.*

2. That the time lost in loading, unloading, and all other ways, per load (except in turning,) is, at an average, *two-thirds of a minute.*

3. That in every complete turn, or semicircle, described by the horses, *one-third of a minute is lost.*

4. That if the mean horizontal distance of transportation of the earth in a right line, *be added to* the extreme height scooped, measur-

ing vertically from the bottom of the excavation to the top of the bank, then for every 70 feet of this aggregate distance, *one minute* will be consumed by the horses in going out and returning back.

5. That if the earth be all scooped to *one side*, as for instance, to the tow-path bank alone, of a canal, *two turns, or a complete circle*, will be made by the horses, for every load deposited in bank.

6. That if the earth be scooped to *both sides* of a canal, but *one turn, or a semicircle only*, will be described by the horses, for each load put in bank.

From the 5th and 6th observations, it follows that clear of the time needed to overcome the horizontal haul and vertical height, the constant amount of time lost per load, will be:

In Double Scooping.—Time lost in loading, &c., $= \frac{2}{3}$ minutes.
Do. in turning *once*, $= \frac{1}{3}$ "
Total, $= 1$ "

In Side Scooping.—Time lost in loading, &c., $= \frac{2}{3}$ minutes.
Do. in turning *twice*, $= \frac{2}{3}$ "
Total, $= 1\frac{1}{3}$

Now if the sum of the mean horizontal haul, and the extreme height scooped, both in feet, be put $= a$
The number of hours wrought per day, $= b$
The number of cubic yards excavated and placed in bank, per day, by each scoop, $= x$
Then the general formula to find x in *double scooping* will be:

$$\frac{\left(\frac{60}{\frac{a}{70}+1}\right) b}{10} = x.$$

Transforming this equation by the rules of algebraic fractions, and substituting for b the average number of hours commonly wrought per day, $= 10$, we are able to reduce the formula to the following:

In Double Scooping, $\frac{4200}{a+70} = x$ . . . I.

And for *side scooping* the general formula will be:

$$\frac{\left(\frac{60}{\frac{a}{70}+1\frac{1}{3}}\right) b}{10} = x.$$

Transforming which, by the rules of algebraic fractions, we have:

In Side Scooping, $\frac{4200}{a + 93\frac{1}{3}} = x$ . . . . . II.

Now putting *the cost per cubic yard of excavation put in bank clear of all profit,* - - - - - $= y$

The daily wages of a scoop and driver, in cents, $= c$

The cost per cubic yard, in cents, of loosening the earth, $= d$

The formula to find y, the cost in cents per yard, either in double or single scooping, will be:

$$\frac{c}{x} + d = y \quad - \quad - \quad \text{III.}$$

The actual number of cubic yards excavated and put in bank by *scoops,* in several instances, having become accurately known to the writer, the correctness of the formulæ I and II will be tested by those cases.

Example I. Double Scooping.

In this case, 3600 cubic yards of earth were excavated and put in bank by 90 days work of *scoops,* or per scoop, per day, = 40 cubic yards, - - - - - - - $= x$

The mean horizontal haul was $= 26\frac{1}{2}$ feet.

The extreme height scooped, $= 8$

Aggregate distance, - - $= 34\frac{1}{2}$ $= a$

Then by the formula I we have:

I. $\frac{4200}{a + 70} = x$ or $\frac{4200}{34\frac{1}{2} + 70} = \frac{4200}{\frac{209}{2}} = \frac{8400}{209} = 40\frac{2}{10}$ c. yds. $= x$.

Here the calculated and actual days work of the scoops is the same within $\frac{2}{10}$ of a cubic yard.

Example II. Single or Side Scooping.

In this case, 5000 cubic yards of earth were excavated and deposited in bank by 176 days work of scoops, or per scoop per day, = $28\frac{1}{2}$ cubic yards, - - - - - - $= x$.

The mean horizontal haul was $= 44$ feet.

The extreme height scooped, $= 11$ "

Aggregate distance, - - - $= 55$ - - $= a$.

Then by the formula II we have:

II. $\frac{4200}{a + 93\frac{1}{3}} = x$ or $\frac{4200}{55 + 93\frac{1}{3}} = \frac{4200}{\frac{445}{3}} = \frac{12600}{445} = 28\frac{3}{10}$ c. yd. $= x$.

Here the difference between the real and calculated days work of a scoop is $\frac{1}{7}$ of a yard.

Conceiving it to be unnecessary to display at length any more of the examples, we will embody, in the following table, the results of actual experiments, and compare them with those calculated by the formulæ.

1	2	3	4	5	6	7	8	9	10
No. of experiment.	Kind of scooping.	Mean horizontal haul.	Extreme height scooped.	Value of *a.* or sum of cols. 3 and 4.	No. cub. yds. excavated & put in bank.	Days work of scoops employed in doing the work stated in column 6.	No. of cubic yards actually excavated per day by each scoop.	No. of cubic yards excavated per day per scoop; calculated by formulæ I. and II.	Cost per cub. yd. of the excavation calculated by formula III.
1	Double.	$26\frac{1}{2}$	8	$34\frac{1}{2}$	5000	126	$39\frac{7}{10}$	$40\frac{2}{10}$	$7\frac{8}{10}$
2	Double.	$26\frac{1}{2}$	8	$34\frac{1}{2}$	3600	90	40	$40\frac{2}{10}$	$7\frac{8}{10}$
3	Side.	44	11	55	5000	176	$28\frac{5}{10}$	$28\frac{3}{10}$	$10\frac{7}{10}$
4	Side.	36	6	42	5610	181	31	31	$9\frac{9}{10}$
5	Side.	40	9	49	852	$28\frac{1}{2}$	30	$29\frac{1}{2}$	$10\frac{3}{10}$

In calculating column 10 of the above table, the hire per day of a *scoop and driver*, has been assumed to be 275 cents, and the cost of loosening, at 1 cent per cubic yard.

The near coincidence of the results in columns 8 and 9, shows how closely the calculated number of cubic yards, excavated per day, in each of the kinds of scooping, agrees with the real days work *of each scoop*, as actually ascertained in excavating 20,062 cubic yards of earth; consequently we may regard the formulæ which we have deduced, *as being sufficiently confirmed to justify a full reliance upon them in practice.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Compression of Earth, and the Increase of Rock in Embankment, Compared with the Volume in Excavation. By Ellwood Morris, *Civil Engineer.*

I. *On the Compression of Earth in Bank.*

It is well known to practical engineers, that when earth is excavated and formed into embankment, it occupies *less space in bank* than in the cut whence it came.

Although experience has sufficiently established this fact, yet a contrary opinion is often entertained by persons who have not bestowed much attention upon such affairs; and this idea is encouraged by inadvertent paragraphs, which are sometimes met with in works of high professional authority.*

Thus even in Professor Mahan's able treatise upon Civil Engineering, (page 118,) we find the following sentences:

"In determining the relations between the volumes of the embankments, and the excavations by which they are furnished, it must also be borne in mind that earth, in its natural state, occupies less space than when broken up; and as the embankments, when first formed, are in the state of earth newly broken up, an allowance must be made according to the nature of the soil. This allowance will generally vary between one-twelfth and one-eighth; that is, earth, when first broken up, will occupy from one-twelfth to one-eighth more bulk than it does in its natural state."

Now, so far from this being the case with embankments of earth, it is directly the reverse, and the fact is in practice, that the *compression*, and not the *expansion*, of earth, when formed into bank, is usually found to be from *an eighth to a twelfth part* of its volume in the natural state.

Although it is evident that a subject of this nature does not admit of a precise determination, because an almost endless variety exists in the consistency, and hence in the compressibility of earths; still it is quite possible to form an approximation which will not, in general, err very far.

A few years ago the writer made some observations upon embankments formed from excavations, in three different cases, and upon a tolerably large scale, where the accurate cubic content, both of cut and bank, was known, and the amount of the latter exceeded *thirty-nine thousand* cubic yards.

The details of these experiments, all of which refer to banks formed in layers by cart and scoop, are to be found in the following statement, of which we may further observe, that one winter intervened between the commencement and completion of each bank.

* The most common error upon this subject, which we meet with in books, is the supposition that a certain amount of earth excavation, will form the same quantity of embankment; which, in practice, can never be the case in banks that are made with carts.

Thus in Professor Millington's excellent "Elements of Civil Engineering," we find it stated (at page 184,) that by a particular arrangement of levels, "one-half of the canal will be in excavation, and the remaining half in embankment, and the soil that is dug out of one end will serve to form the embankment at the other." The same idea runs through other works, which we might quote if it were necessary.

Number of the embankment.	Earth excavated to form each embankment.	Embankment made by the preceding quantities of earth.	Shrinkage or compression of the earth in bank.	Rate of the compression of the earth in bank.	Remarks.
	Cubic yards.	Cubic yards.	Cubic yards.	Cubic yards.	
1	6970	6262	708	$\frac{100}{984}$	Yellow clayey soil.
2	25975	23571	2404	$\frac{100}{1086}$	Ditto.
3	10701	9317	1384	$\frac{100}{773}$	Light sandy soil.
Total.	43646	39150	4496	$\frac{1}{10}$	average compression.

By these tabulated observations, we perceive that 43,646 cubic yards of earth, transferred from its natural locality into the embankment of a public work, suffered by the operation a diminution, or shrinkage, in bulk, of 4,496 cubic yards, or *one-tenth* of its mass.

Some other observations, upon a smaller scale, indicated that the compression which took place in *gravelly earth*, when used for embankment, amounted to about *one-twelfth* of its bulk in the cutting.

Consequently, at least until more ample experiments are made, these results seem sufficient to justify the assumption of the following rates for the *compression of earth in bank*,* viz.

In light sandy earth, $\frac{1}{8}$ of the volume in excavation.
In yellow clayey earth, $\frac{1}{10}$ "
In gravelly earth, $\frac{1}{12}$ "

In computations made for the purpose of equalizing the excavation and embankment upon roads, canals, or railroads, a strict attention to

* As an example of the practical operation of these principles; suppose a contractor to have undertaken the formation of an earth cutting, and a contiguous embankment of greater amount, in which the earth excavation is to be used.

Let the amount of the earth cutting = 25,000 cubic yards at 25 cents per cubic yard.
" Embankment = 40,000 " at 30 cents per cub. yd. for that *not from cut.*

Then if we neglect *the compression of earth in bank*, there would be but 15,000 cubic yards of embankment not from excavation, and the amount of the contract would be,

25,000 cubic yards excavation of earth, at 25 cents, . = $ 6,250
15,000 cubic yards embankment, *not from cut*, at 30 cents, = 4,500

Total, = $ 10,750

But as we have shown above, that the earth, when formed into bank, would, in fact, com-

the above considerations is indispensably requisite; for if they are neglected, it will be found that excavations, which have been laid out as sufficient to furnish the materials for a given embankment, will be deficient in quantity, and an unexpected resort to side cutting will become necessary to complete the bank, as has been witnessed by the writer in more than one instance.

In tracing out a canal, if the depth of cutting sought by the centre line, as necessary to form the banks from the excavation of the trunk, has been calculated without due allowance for *the compression of earth in bank*, the trunk of the canal will not supply material enough, and a resort either to cutting below bottom, or to side trenches, will become unavoidable, to make up the amount deficient.

II. On the Increase of Rock in Bank.

By careful observations made by the writer, it was found that the excavation of 22,625 cubic yards of *hard sand-stone rock, which quarried in large fragments*, formed 32,395 cubic yards of embankment; showing that in this instance, the increase of the rock in bank was 9,770 cubic yards, or about *five-twelfths* of its volume measured in the cut.

In another case, it was noticed that the excavation of 16,982 cubic yards of *blue slate rock, that broke up into small pieces*, formed 27,131 cubic yards of embankment; showing that here the increase of the rock in bank amounted to 10,149 cubic yards, or nearly *six-tenths* of its measured bulk in the cutting.

From these observations, made upon the increase of near *forty thousand* cubic yards of rock-cutting carried into bank, it would seem that the augmentation was about *one-half;* but as in lime-stone, and other rocks, it might be found to vary, both with their relative frangibility, and the dimensions of their quarried fragments, more ex-

press, or shrink, about one-tenth; the actual quantity of embankment which it would be necessary to supply *not from excavation*, would be as follows:

Gross amount of the bank, ...	= 40,000 cubic yards.
Bank made from cut $= 25{,}000 - \frac{25{,}000}{10}$	= 22,500 "
Leaves embankment *not from cut*, . . .	= 17,500 "
And the amount of the contract ought really to be,	
25,000 cubic yards excavation of earth, at 25 cents,	= $ 6,250
17,500 cubic yards embankment *not from cut*, at 30 cents,	= 5,250
Total,	$ 11,500

This last amount being $ 750 *greater* than the former, shows how injuriously the interests of undertakers of works might be affected, if we failed to make due allowance, in calculating deficient embankment, for the *compression of earth in bank.*

periments upon this point appear to be necessary to enable correct rules to be framed.

Philadelphia, September 1st, 1841.

Railways in Germany.—EMPEROR FERDINAND'S *Northern Road.* (*From Vienna to Bochnia, in Galicia, with Branches.*)

CONTINUED FROM PAGE 180.

The project for this railway, which is the most extensive as yet undertaken in Europe, was conceived already in 1830; from that time up to the year 1836, various local investigations, as well as an examination of the railways executed in England and Belgium, had been made by the banking house of Baron Rothschild, in Vienna, to whom, on application, the imperial privilege was finally granted, on the 4th of March, 1836, authorizing the formation of a Company of shareholders for the construction of a railway from Vienna, the capital of the Austrian empire, to Bochnia, in Galicia, with branches to Brunn, Olmutz, Troppau, Dwory, and Wielitchka. The provisions of this charter are of the most liberal nature; in regard to the right of way the same laws are to be observed as in the establishment of public turnpike roads by Government; no restrictions are made as to the tariff, and during fifty years no rival railway can be constructed between the above designated points. After fifty years the privilege expires, but may be renewed, the road and appurtenances remaining to the Company for ever.

Immediately after, an arrangement was entered into between the house of Rothschild and a provisory committee, formed by the first subscribers to the stock. Subscriptions were received for 6,000 shares (at £100,) which, with the 8,000 retained by the owner of the privilege, for himself and his friends, formed a capital stock of £1,400,000 (fourteen millions of florins.) This amount was deemed sufficient for the accomplishment of the work. The instalments were made at £10 every half-year, the first on the 30th of April, 1836, the last on the 15th of October, 1840; from the time of the first payment, made by the stockholders, they receive an interest at the rate of 4 per cent. per annum.

The charter provided that five miles of the railway were to be completed within two years, and the whole line to Bochnia within ten years from the day the privilege was granted. Accordingly, with the necessary means on hand, operations were immediately commenced, by making the surveys and plans for the section from Vienna to Brunn; the ground was first broken on the 7th of April, 1837, and the works prosecuted with the utmost vigour, from 10,000 to 12,000 labourers having been constantly employed on the line. Already, in November of the same year, the first trips were made to Wagram, a distance of seven miles; in August, 1838, nineteen miles of the railway were put into operation, and the whole line to Brunn, of ninety-one miles in length, was opened on the 7th of July, 1839, or in two years and three months after the commencement of the work. At

the same time the works in the main line towards Galicia were steadily progressing, and on the 1st of November, 1840, the following sections were nearly completed:—

	Miles.
From Vienna to Lundenburg and Brunn, (opened,)	91
" Lundenburg to Hradish, (main line,) - -	30
" Near Vienna to Stockerau, (a branch,) -	14
Length of railway completed, or nearly so, - -	135
The following sections are in progress of construction:—	
From Hradish to Prerau (main line,) - - -	30
Branch to Olmutz, - - - - -	15
Total completed and in progress, - - -	180

At the same time the surveys are now making for the other parts of the main line, and those branches yet to be constructed. The total length of the railway, with all its branches, will not fall short of 400 miles, which is certainly the greatest extent of any work of this kind yet undertaken in Europe by a single Company. The total amount already expended exceeds ten millions of florins, or one million sterling.

The railway derives its name from its traversing the northern provinces of the empire; amongst its principal objects is the transportation of oxen from Galicia to the Residence, the number of which, according to official data, amounts, annually, to more than 90,000. It will, in every case, contribute largely to develop the resources of those provinces, and become the more important by the connexion with the Warsaw and Vienna railway, now in progress. An uninterrupted line of railway will then exist between the Vistula and the Danube, connecting the Baltic with the Black Sea.

In the following a more detailed account is given of the construction, management, and operations of that part of the Emperor Ferdinand's Northern Railway, which has been for some time in use, viz. of the line from Vienna to Brunn, the capital of Moravia.

The railway commences at the Prater, a little distant rather from the centre, but still within the barriers of the city and suburbs. There is a spacious station, with extensive buildings for the passenger and freight departments, and for the repairing of engines and cars, destined to accommodate not only the line to Brunn, but of the whole railway. After leaving the depot, the railway crosses two arms of the Danube, by wooden bridges, which are both 1,960 feet in length. These bridges are built very light, in order not to put a permanent obstacle against the floating ice during the spring freshets, the accumulation of which might otherwise cause an inundation of the adjoining country. Having crossed the valley of the Danube, the line pursues a north-eastern course, and reaches the river March, which forms the boundary between Lower Austria and Hungary. After following, for a considerable distance, the course of this river, it crosses the Thaya at Lundenburg by numerous bridges. There, at a point

fifty miles from the city of Vienna, the branch road to Brunn parts from the main line, and follows the course of the Thaya and Shwarza until it reaches that capital, while the main line pursues its course in the valley of the March. The railway, although not very direct in its course, has, notwithstanding, several straight lines of considerable length, and the curves are all of very large radii. The whole distance from Vienna to Brunn is, as already mentioned, ninety-one miles.

The railway rises gradually towards the north, with moderate grades. The steepest inclination is nineteen feet per mile, and occurs only once for a short distance. The first nineteen miles of railway are graded for a double track, in order to accommodate a branch, which is to lead to Presburg, in Hungary; the remainder will only have a single track. The excavations and embankments were in some parts very considerable; the greatest height of the latter is thirty-eight feet. At Brunn the railway terminates upon a long viaduct over the valley of the Shwarza, consisting of eighty arches, seven of which have a span of thirty-one feet, the others of twenty-five feet. The total length is 2,383 feet. Of the works executed the following will give the best idea:—Excavations and embankments, 6,012,500 cubic yards, of which 140,000 cubic yards were excavation in solid rock. Length of wooden bridges, 3,708 feet; length of wooden bridges with stone abutments and piers, 488 feet; number of stone bridges and viaducts, twenty-four, with 228 arches; number of culverts, 116; of road crossings, 198; of which thirty-one are under, six over, and the remainder level, with the railway.

The superstructure is made as follows:—Cross ties of wood, formed of half trees of oak, larch, or fir, seven and three-quarter feet in length, and twelve inches in diameter, are laid three feet six inches from each other, upon a layer of gravel, twelve inches thick. Iron rails of forty pounds per yard, of the common T pattern, rest in chairs upon every sleeper, and are kept fast by iron keys, or wedges. The chairs used at the joints of the rails weigh fourteen pounds, the others, ten pounds. The width of the track is four feet eight and one-half inches. The rails were partly imported from England, and partly manufactured in Austria, but owing to the high freight and duty upon the imported rails, and to the inexperience in the manufacture of this article at home, the cost per ton of rails delivered to the road was in both cases not less than from £27 to £27¼. The price of the chairs was £9 per ton.

Besides the principal station at Vienna, which was mentioned above, there is a similar large one at Brunn, and smaller buildings are on nine intermediate stopping places on the road, containing also cisterns, in which the water is heated before it is filled into the tenders. There are besides, along the line of the railway, eighty small houses, for as many watchmen.

For carrying on the transportation business the Company own now twenty-two locomotive engines, of which seventeen were built in England, two in Belgium, two in America, and one in Vienna. Of the engines constructed in England, twelve are from Messrs. Robert

Stephenson and Co., two from Jones and Co., two from Turner, Evans and Co., and one from G. and J. Rennie. All the English engines have six wheels, the driving wheels, as usual, in the middle. The two American locomotives were manufactured by William Norris, of Philadelphia; they are much smaller than the English, have also six wheels, but the driving wheels are behind, and the fore wheels supporting a truck, movable round a centre. These latter wheels are only thirty inches in diameter. Another engine is to arrive in a short time from Philadelphia, from the known manufactory of Messrs. Baldwin, Vail & Husty, which has furnished, since 1832, over 150 engines for the American railroads, and two more engines are expected from Messrs. Sharp, Roberts and Co., of Manchester.

The passenger carriages used upon the railway are of three different classes, and built, as in England, all upon four wheels. The same is the case with the freight wagons; both carriages and wagons are built in the Company's own shops.

The following was the expenditure for the railway from Vienna to Brunn, up to the 1st November, 1839:—

	£	s.
For preliminary surveys, &c.,	2,655	18
Right of way,	48,721	14
Grading and bridges,	136,070	18
Superstructure: labour,	38,603	0
" timber,	26,555	8
" iron,	167,274	5
Turnouts and turntables,	3,917	16
Station buildings, work-shops, watch-houses, furniture, utensils, and tools,	22,297	12
Engines and carriages, &c.,	40,510	9
Cost of administration,	3,096	14
Interest paid to stockholders,	15,626	8
Total,	505,330	2

Since the 1st of November, 1839, there have been expended about £32,000 more, making the total cost of the railway, with buildings, locomotives, carriages, &c., equal to £537,000. This is for seventy-two miles of single, and nineteen miles of double track. This sum divided by ninety-one gives the average cost per mile of railway, with all appurtenances, £5,900, including also the interest on the capital of construction up to the time the line has been opened.

The chief engineers of the railway were Messrs. Ghega and Bretschneider. On the opening of the whole line, the 7th of July, 1839, four trains, with 1,200 persons, started from Vienna, and reached the capital of Moravia in four hours. In returning, however, a sad accident occurred at one of the stations, by the concussion of two trains following each other too closely: several persons were more or less severely injured, much to the disappointment and grief of the Directors, who saw the festival end in such a melancholy manner. This and some further accidents, which may happen on every railway,

particularly in the first period of its operations, tended much to bring the undertaking into discredit amongst the public, and occasioned some severe measures and investigations on the part of the authorities.

The Vienna and Brunn railway is used for the transportation of both passengers and freight. The former are conveyed in three different classes of carriages, and pay for the whole distance, in

Carriages of 1st class,	- -	12s. or 1.582d. per mile.
" 2nd class,	-	8s. or 1.005d. "
" 3rd class,	- -	6s. or 0.791d. "

Each passenger is allowed forty pounds of baggage; if the weight is greater, he has to pay at the rate of 0.42d. per cwt. per mile. Passengers may procure receipts for their baggage by paying 2d., and can, in such case, deliver the latter the day previous to their departure. If the baggage be lost on the road they can recover the amount of £2 10s. for a trunk, £1 10s. for a valise, and 10s. for a parcel; but may, if they choose, also insure the whole value of the baggage; the rate of insurance being one-tenth per cent.

In summer two trains are daily starting from each end of the line, one early in the morning, and one in the afternoon; in winter, one train from each end is sufficient. The passenger trains travel at the rate of twenty to twenty-three miles per hour, and perform the whole distance in from five to five and one-half hours, including stoppages at nine intermediate stations.

Freight is carried in extra trains, with an average speed of fourteen miles per hour. Passengers going with the freight trains pay two-thirds of the usual fare. The charges for freight are different, according to the specific weight and value of the articles; in the tariff all articles are divided into four classes, and the charges are, for articles of the first class, 1.9d.; of the second, 2.3d.; of the third, 3.1d.; and of the fourth, 3.9d. per ton, per mile: the average charge for freight is, therefore, 2.8d per ton, per mile. Parties preferring to load a whole wagon pay from 2s. 6d. to 3s., the load, in such case, not to exceed three and one-third tons. The Company guarantee only for such goods as have been insured by the proprietors; the rate of insurance is fixed at one-twentieth per cent.

The income of the road has been constantly on the increase since it was put into operation. In the year 1838, from April to October 31st, when only a small part of the line was in use, the income from passengers amounted to - - - £ 3,346 5s.

From 1st November, 1838, to 30th April, 1839, upon nineteen miles, the number of passengers carried was 58,143, the income, - - -	2,706 17
From 1st May to 7th July, 1839, the length of road in operation nineteen to fifty miles; number of passengers conveyed, 65,994, income, - -	4,238 12
From 7th July to 31st October, 1839, the whole line in operation; passengers, 139,749; income, -	18,070 12
Income from freight, - - - -	704 3
Total to 1st November, 1839, - -	£ 29,066 9

The revenue in the six months, from 1st of May to 1st November, 1839, amounted to £ 23,013 7s.; in the corresponding half year of 1840, the revenue was:—

From 144,354 passengers, - - -	£ 26,163	18s.
" 18,616 tons of goods, - -	11,466	12
Total, - - - -	£ 37,630	10

This gross income is at the rate of fourteen per cent. per annum, on the capital of construction of £537,000.

The Directors have not yet published their report for the year 1840, from which the expenditure for managing the road could be ascertained for this last year. The following is an account of the expenditure for the period of six months, viz. from 1st May to 1st November, 1839. It is to be considered that the average length of railway in operation during this period was only 72 miles.

For salaries to persons in the technical department, viz:—to engineers, assistants, and superintendents,	£ 632	1s.
Watchmen on the line and stations, - -	747	1
Persons in the transportation department, viz., collectors, conductors, &c., - - -	471	3
Persons in the mechanical department, viz. superintendent of work-shops, engine, and firemen, &c.,	1,113	11
Wages to men repairing railway, - -	531	14
Traveling expenses, remunerations and damages,	222	13
Office expenses, printing, &c., - - -	699	16
Equipments, utensils, requisites, &c. of persons employed in the different departments, -	354	12
House rent in Vienna and Brunn, - -	41	11
Repairs of engines and cars, - - -	1,719	12
Oil, hemp, tallow, soap, candles, grease, &c., -	736	10
Torches and signals, - - -	103	4
Fuel: stone coal, and coke, - - -	5,275	17
" wood, - - - - -	278	13
" oil cakes, - - - - -	10	17
General expenses: administration, and some extraordinary charges, - - - -	720	8
Total expenditure in six months, -	£ 13,659	3

Recapitulation: income from 1st May to 1st November, 1839, - - - - -	£ 23,013	7
" expenditure ditto, - -	13,659	3
Net profit, - - - -	£ 9,354	4

The expenditure amounted, therefore, to near sixty per cent. of the gross receipts, and the net profit was one and three-quarter per cent. of the capital invested, in the six months above mentioned. In the year ending 31st of October, 1840, the net revenue has amounted, probably, to at least six per cent. on the capital expended.

The reason of the great expenditure is, principally, the high price of coke and coal, which makes the item of fuel amount to over forty per cent. of the total expenses. The coal, of which the Company make their coke, has to be brought from a very great distance, and a ton of coke has cost them, hitherto, not less than £2 14s. The use of wood has been tried, but abandoned again, on account of the sparks.

[TO BE CONTINUED.]

Architecture.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Alleged Degeneracy of Modern Architecture. *By* ROBERT CARY LONG, *Architect, Baltimore, Maryland.*

I have noticed, with great pleasure, that in the new series of the Journal of the Franklin Institute, a place has been set apart for architecture.

This is as it should be. It is as well the duty, as the interest, of architects, to enlighten public opinion on the subject of their profession; their duty, because the art they practice is in a high degree refining and ennobling in its influences on the public mind; their interest, because architects cannot live unless the value of the art is recognized, understood, and properly appreciated. People understand, well enough, that they should be careful in choosing those who are to represent them in legislative assemblies; but how lamentably do they neglect that art, whose products represent them, not only to the present age, and in the eyes of cotemporaries, but which are to declare to future generations "what manner of men they were."

In the present condition of things, the enlightenment of public opinion will unquestionably depend on architects themselves, as there are none others who seem to know or care much about it.

As an earnest of *my* interest in the subject, I am induced to disburden myself of sundry thoughts which have suggested themselves, from constantly meeting in the foreign reviews and magazines, the oft-repeated allegation of "the degeneracy of modern architecture."

What do the critics mean by "degeneracy of modern architecture?" It is a stereotyped phrase used by both great and small writers, and, by the frequency of it, we cannot but believe that it means something. When we look, however, into the books, or consult the magazine-articles of said critics, we are puzzled to find out, exactly, what this something is.

If we listen to some of them, we must needs conclude that there never was any architecture but the Gothic, and that there never will be any again until the Gothic is *revived*, thus admitting that Gothic

architecture is now dead, in a stupor, or else has fainted away in very weakness.

From another set of essayists, we learn that Palladio first invented that thing called architecture; that, before his time, people built, "every man according to what was right in his own eyes," until Palladio taught them better, and gave such unerring rules for the production of design in architecture, showing so indisputably what is beautiful and what is not, that thence forward the simplest tyro in art need never go astray.

Hear also your modern Greek, swelling with all the grandeur of the age of Pericles, and familiar with the proportions of the Parthenon, he will tell us that other nations have, in divers ways to be sure, built temples; the Egyptians, for instance, had a few, and in the dark ages, among the barbarians of Europe, a strange kind of a structure, called a cathedral, was erected in a most barbarous manner, without columns, entablatures, or pediment; the principal characteristics being great overgrown windows, and sharp spires, or steeples, running up into the air; all this, however, they aver, was not architecture, because architecture consists of three orders, and a building that has not one of these three orders is of no order of architecture, but is mere disorder, and cannot, in the nature of things, be considered as a production of architecture. Indeed, it may be questioned, whether the veritable temple of Solomon, built by the wisest man on the earth, and according to the express directions of the Almighty, or that tabernacle which Moses built, "according to the pattern shown him on the Mount," if discovered by these modern Greeks to be of no one of their three orders, would not be pronounced by them to be entirely out of proportion, and that the builders must have made a mistake, certainly had never read Vitruvius.

Widely, however, as these scholiasts differ, there is one point upon which they all agree, and this is, they all equally deplore the *degeneracy* of modern architecture, and cry loudly for the *revival* of some one favourite style, in order to regenerate the defunct art.

But let us inquire what do the critics mean by "the degeneracy of modern architecture." Is it degenerate because it is not Gothic; because it is not Greek, not Palladian, not Elizabethan, not Egyptian? If so, then in truth we say, architecture will never be any thing else but degenerate, unless we either turn Greeks, or Romans, or Egyptians, &c., and assuredly no one believes that such is ever going to be the case.

Yet why are architects taking it for granted that nothing is architectural unless it be either Greek or Gothic, or some other style, and that, if drawing from these sources they did not try to throw into

their designs a portico, a pediment, or fasten buttresses and pinnacles to the outside walls, or shape the door and window heads into some particular curve, or arch, or indeed apply any other features which can be taken entire out of books, that all trace of architectural art would vanish from the earth? These are *civilized* times, and men require houses to live in; they worship God, and must build temples, if not for His glory, at least for their own comfort, and in ministering to these requirements, this practice of pinning to a building appropriated to either of the above uses, some of the embellishments of another building, held as classic precedent, producing excrescences which architects seem to think are the only things about the structure which have any right to the name of architecture, is, in fact, the great hindrance to the natural growth of architecture. It is *this* practice which is the degeneracy of modern architecture.

Is it to be supposed that Grecian architecture would ever have grown to what it is, if the architects of that land had not given free room for the genius of their country, and its institutions, to manifest itself architecturally? Imagine *them* believing that the Egyptian was the only correct architecture, and insisting on sloping the sides of their buildings, placing their columns within the walls, and hiding their sloping roofs, necessary for the climate, behind an immense horizontal entablature. What a monster would have frowned from the heights of the Acropolis, instead of the ever living edifice that stood there glowing with the life, the youth, the poetry of Greece.

Why was it that the Romans never attained to an original style of architecture, although they had, to begin with, that emblem of strength and beauty, the arch, as an elemental national feature? Simply because they believed that the Greek was the only architecture in the world. They therefore modestly used the arch as a constructive element, and imprisoned it within an external Greek façade, binding the free curve of their own glorious arch under the dominion of column and entablature. This was to put the full blooded Arabian courser into the harness of Juno's peacocks, and then wonder to see the goddess upset, the harness broken, and the chariot shivered.

Thus it was that the arch, with the Romans, never gave birth, as it should have done, to a national style, and yet we see how, in different hands, out of that same arch and its wonderful capabilities, the Norman style was formed, and thence by true artistic treatment, managing this same arch with the buttress, it became the most yielding thing in art-creation, the graceful, the flexible Gothic, coming out of it "as sweetness out of strength," honey indeed "out of the jaws of the lion."

And yet the degeneracy of architecture is now loudly talked of,

and no one sees at the present day *how* any thing new is ever to be done in that art, except by adherence to the rules, not according to which any greatness in architecture was ever achieved, but according to which you may copy any given production of the art.

According to these same critics, it would be easy to show that modern architecture is not by any means degenerate, if their own rules of perfection are at all good for any thing. Is the Parthenon good architecture? What hinders us from building a Parthenon? The money being given, we could re-produce that, or any other building that has been be-measured as the Parthenon has been. Is York-minster good architecture? Then the front of the new national Scotch church, in London, is assuredly good architecture enough to content one, for it is as near a fac-similie of the west front of York cathedral as modern means will allow. Indeed, do we not possess already a modern specimen of every conceivable style that has existed in any quarter of the globe? Surely then, according to such views, our architecture is not degenerate. But has this endless repetition of the architecture of the past, any title to be called the architecture of the present? is this the way to produce any thing new, or good, or great, in architecture, any thing bearing on it the impress of the characteristics of this generation, any thing homogeneous with the advanced state of civilization?

Truly, indeed, modern architecture is degenerate, is utterly dead, we should say, in view of what we have just shown, (for if there is any modern architecture at all, what, and where is it?) did we not possess a cheerful faith, which is ever telling us that architecture is too intimately connected with man to perish while there is a man upon the earth. Must *man* progress in goodness and in wisdom? then must *architecture* also! Is man so progressing? then is architecture also, though we may not know it nor see it. Architecture must manifest the changes that are taking place in society, the greater ones, we hope and believe, that are yet to come.

It is as much out of the rule of rationality to think it possible to re-invigorate architecture by forcing it into any antique mould, as to expect that, if disgusted with manhood, we can bring back simplicity and innocence by putting on again the garments of youth. Architecture must grow naturally, its own peculiar tendencies must be observed, and it must be trained accordingly. How is this to be done? let us all try to find out, let us all try and see which of us will first produce something in the art peculiar—characteristic—suited to the age—national.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1840.

With Remarks and Exemplifications by the Editor.

1. For constructing *Truss Frames, principally intended for Bridges;* William Howe, Warren, Worcester county, Massachusetts, August 3.

This bridge is, in many respects, similar to that patented by the same person on the 10th of July last, and noticed in our last number, but instead of wedges, screws are used for cambering the bridge, and instead of posts, extending from the lower to the upper string piece, iron bolts, with a screw and nut at the top, are employed. The first set of braces and counter braces, start from the top and bottom of the first bolt, pass by the second, and abut against the top and bottom of the third—the second set commence from the second bolt, pass the third, and abut against the fourth, and so on to the end of the bridge. The screw bolts pass through wedge pieces of wood, at top and bottom, and the ends of the braces and counter-braces, abut against them, instead of against the screw bolts. By this arrangement it will be seen that as the upper and lower strings may be brought nearer together by screwing the nuts on the ends of the screw bolts, and that the action of the braces and counter-braces will thereby camber the truss.

Claim.—"What I claim as constituting my invention in the above described truss frame, and which I desire to secure by letters patent, is the manner in which I have combined the iron bolts, and the wedge pieces, against which the braces and counter-braces abut, so as to cooperate in increasing the camber to any desired extent, the whole truss frame being constructed, and acting substantially, as herein set forth."

2. For a machine for *Cleaning Grain;* Amos Adams, Port Henry, Essex county, New York, August 3.

This machine is, in its general construction, old; its novelty consists simply in covering a revolving cylindrical screw, which works on a fixed horizontal axis placed at the top of the conical beater, with wire gauze, the meshes of which are of different sizes. That end of it in which the grain is fed, is covered with wire gauze of such fineness as not to allow the grain to pass through, but to permit the escape of the dust, and the remainder is covered with gauze of larger meshes, so as to permit the escape of the grain, but not of substances which are larger than the grain, these creeping through the open end of the screen. The patentee also combines such a screw with a revolving vertical beater and case, in which the grain is to be beaten and cleaned. The grain is fed in from the revolving screen, between the revolving beaters and the outer case, by means of a hopper.

The claim is to the "manner of constructing the revolving feeding screen, and of combining it with the body of the instrument in which the beating and agitation of the grain are effected, as herein set forth."

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3. For a *Machine for Throwing Balls and other Bodies;* Joseph Martin, Louisville, Kentucky, August 3.

This patent is for improvements on a machine for throwing balls by "centrifugal and projectile forces," patented by Robert M'Carty, of New York, on the 31st of December, 1838, and noticed at page 380 of the 24th volume, second series, of this Journal; the objections there made by us we deem equally applicable to the plan under consideration.

We omit the claims, as they refer, throughout, to the drawings, and could not be understood without them.

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4. For a *Mill for Breaking and Grinding Bark;* Richard Montgomery, and Lewis W. Harris, Sargerfied, Oneida county, New York, August 12.

This mill purports to be an improvement on that kind of bark grinder and breaker, in which a nut and case are used, similar to those of the common coffee-mill; and it consists simply in attaching to these, by means of arms, one, or more, concentric nuts, or grinders, and cases. The second and third, &c. nut, or grinder, have teeth on the inside as well as outside, and the inside teeth of the second grinder act against teeth on the outside of the case of the first, or central, nut, and the outside teeth act against teeth on the inside of the second case. The nuts, or grinders, are united by arms at the bottom, and the cases by arms, or braces, at the top, between which the bark, &c., is fed.

The claim is to the "combination of the conical nuts, two, or more, with the cylinders (cases,) placed concentrically."

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5. For an improved mode of constructing the *Packing for Pistons, &c. of Steam Engines;* Charles F. Pike, Providence, Rhode Island, August 12.

(See specification.)

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6. For a machine for *Beveling Boot Forms;* Elijah Holmes, Stoughton, Norfolk county, Massachusetts, August 12.

The boot form is attached to a frame placed upon a suitable bench, provided with guide grooves, into which pins, projecting from the bottom of the frame, fit, to guide the boot form, so as to receive the proper shape when presented to a double cutter wheel, which revolves horizontally. This cutter wheel is provided with a deep groove, and has one set of cutters attached to the upper, and one to the lower part, facing each other, each set forming one-half of the bevel of any desired form.

Claim.—"Having thus described my machinery, I shall claim re-

ducing, or beveling, the edges of boot forms, in the manner herein above explained, by revolving cutters, in combination with a frame for holding the boot form, the said frame having projecting pins, or guides, traveling in grooves, for the purpose of presenting the form in a proper manner to the action of the cutters, the whole being arranged, and operating substantially, in the manner herein above set forth."

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7. For a machine for *Cutting the Teeth of Circular Saws;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, August 12.

The teeth are to be cut by means of a punch worked by a lever, in the usual manner. The saw plate is attached to a circular plate, on the upper end of a vertical spindle, which receives an intermitting rotary motion, so that whilst the punch is cutting off a tooth the spindle is at rest; and when the punch is lifted up clear of the saw plate the spindle is moved around the space of one tooth, its motion being again arrested. This is effected in the following manner. On the spindle there are two toothed wheels, one above the other; the teeth of one are made in the usual manner, and on the other they are slightly inclined with the axis of the spindle. These wheels are acted upon alternately by two horizontal shafts, which receive their motion from the crank shaft, which operates the punch. That which engages with the wheel having inclined cogs, carries a segment of an endless screw; and the other has a grooved piece, and they are so arranged that just as one is disengaged the other commences its action; that with the screw actuates the spindle, and the other keeps it at rest. The size of the teeth to be cut will be regulated by the diameter of the intended saw, and the inclination of the threads of the screw.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the machine above described, consisting in a combination of the said several parts, for giving a regularly intermitted motion to the circular saw plate, and for holding the same still and steady in the intervals of motion, and of the parts for cutting the teeth."

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8. For a machine for *Filing the Teeth of Saws;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, August 12.

The patentee says, "My invention consists in causing the saws, which are to be filed, or smoothed, to pass with a regular intermittent motion of the distance of one tooth under a file, to which a movement is given corresponding with the motion of the saw plate, and the form of the tooth to be filed, and the whole so combined and arranged into parts, that during the time in which the file is acting upon the teeth the plate is holden steadily, and without motion, until the file has performed its office, at the same time giving to the file a peculiar compound motion, which may be varied, so as to be accommodated to the perfect filing of any saw tooth." The motion is given to the saw plate in a manner similar to that of the machine for cutting saw teeth, above noticed. The files used are straight, two being used, one on each side, and crossing each other at any desired angle.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the machine above described, consisting in a combination of the said several parts for giving a regularly intermitted motion to the same plate, and for holding the same still and steady in the interval of motion, and of the parts for filing the teeth."

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9. For an improvement in the *Machine for Sawing Stuff Circular;* Thomas Kenderdine, Jr., Harsam township, Montgomery county, Pennsylvania, August 12.

A saw is to be strained in a frame similarly to those employed by cabinet makers for sawing curves. This frame works on an iron guide rod, permanently attached to standards, and passes through holes made in plates that slide in slots made in the end pieces of the saw frame, so that the saw may be set nearer to, or farther from, the rod on which the frame works. The wood to be sawed is fixed in a clamp attached to a frame, provided with the necessary carriages, &c. The claim is confined to the "use of the guide rod passing through the sides of the saw frame, which is to be made adjustable, so as to adapt it to different curves, as described."

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10. For an improvement in the *Screw Wrench;* Stephen Keane, Thomas Keane, and James Keane, City of New York, August 12.

The movable jaw of this wrench is actuated by means of a screw revolving on a stem attached to the back of said jaw, the threads of which take into worm teeth cut in the edge of the wrench handle.

The claim is confined to the manner of "constructing the movable jaw by combining therewith a revolving screw, whose threads work into worm teeth cut into the edge of the wrench handle."

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11. For a machine for *Sawing and Splitting Timber;* John P. M'Dowell, Summit, Cambria county, Pennsylvania, August 12.

In this machine two circular saws are used, one at each end of a frame, which is hung on an axis, so that either saw can be brought down against the wood to be sawed, whilst the other is elevated, and relieved from the piece which has been cut. The saws are driven by a band passing around a whirl on each saw shaft, and receiving motion from the main shaft, which forms the axis of vibration of the frame. Each end of the main frame of the machine is adapted to receive a log, and is provided with the necessary fixtures for holding it during the operation of sawing, and for gauging the length of the piece to be sawed, which, after being cut off, runs down an inclined plane to a place in the middle of the frame, where it is split by being forced against a set of cutters, by means of a follower.

The claim is confined to the "combination and arrangement of machinery for sawing, with the machinery for splitting logs and other materials."

12. For an *Alarm Lock for Doors;* David Edwards, M'Connelsville, Morgan county, Ohio, August 12.

This patent was granted for the combination of an alarm with a door lock, and for a peculiar arrangement of an escapement, which operates the striker of the alarm bell. The bell, and the machinery which operates the hammer, are placed within the frame, or case, of the lock, and are so arranged that, when set, any attempt to push back the bolt actuates the alarm. We omit the claim, as it refers, throughout, to the drawings.

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13. For a *Machine for Boring and Mortising Chairs, &c.;* William L. Harley, Chagrin Falls, Cuyahoga county, Ohio, August 14.

The first item claimed is, "the construction of the bit, with cutters on the end, and teeth in the sides, in combination with the twist." This bit is formed like the single twist auger, with a cutting lip at the end, cutting edges running the whole length, so as to bore out mortises, by giving to the piece of wood to be mortised a reciprocating movement.

The second item claimed, is the "combination of the two carriages, the lower one resting upon a stationary frame, and moved in it lengthwise by a lever, to give depth to the holes and mortises to be bored, and the upper one moved transversely by a crank, to give length to the mortises." This part of the claim needs no explanation. The third item of claim is to the "construction of the frame for the seats to rest on, so as to be presented obliquely to the bit, in combination with the lower carriage. And the last item is to the "construction of the frame for the legs to rest on, to be presented obliquely to the bit, in combination with the lower carriage." The constructions claimed under the two last sections of the claim can be imagined by mechanics more readily than they can be explained without drawings. These frames are provided with joints and slides, so as to present the part in any desired position. The bit is put in the mandrel of a lathe, and the machine presented to it with any part of a chair which is to be bored or mortised.

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14. For an improvement in the *Rotary Fan Blower for Forges and Furnaces;* James Stewart, Springfield, Robertson county, Tennessee, August 17. Antedated July 1st, 1840.

This improvement consists simply in using two, or more, fan wheels on the same shaft, each contained in a separate chamber; the current generated by the first wheel is received into the second chamber, and passes through the second, third, and so on, if more than two are used. Claim.—"Having thus fully described the nature of my blowing machine, and shown the manner in which the same is carried into operation, what I claim therein as constituting my invention, and desire to secure by letters patent, is the placing of two, or more, fan wheels upon the same shaft, but within separate compartments, combined and connected with each other in the manner herein set forth."

We have seen this machine in operation in blowing a smith's forge, and its action was such as to bespeak real utility; we have not, however, heard of its adoption by mechanics, and suppose, therefore, that it has not redeemed its promise.

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15. For a *Smut Machine for Cleaning Grain;* John Burch, Millport, Chemung county, New York, August 17.

This machine has a cylinder, formed of wove wire, or perforated sheet metal, with triangular ribs, running its whole length within the wire. This cylinder revolves slowly on a horizontal, or nearly horizontal, shaft, whilst the shaft revolves with great rapidity, and carries suitable beaters. The slow revolution of the cylinder furnished with ribs carries up the grain which is discharged upon the beaters. Motion is given to the cylinder and beaters by well known means, which need not, therefore, be described. The claim is confined to the "revolving of the revolving cylinder, with its perforated surface and triangular ribs, with the revolving beaters placed on a shaft in the axis of said cylinder, so as to constitute a grain cleaning, or smut machine, constructed and operating substantially in all respects, in the manner herein set forth."

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16. For an improvement in the *Railway Track, for Turning Short Curves;* Henry M. Naglee, City of Philadelphia, August 17.

(For specification see vol. 27th, p. 171, 2nd series.)

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17. For improvements in the *Dredging Machine*, for deepening Harbours, Rivers, Canals, &c.; William Easby, City of Washington, D. C., August 25.

This machine is intended to be worked by horses, that travel on a circular platform, built on the deck of a large scow. The whole machine is made narrow enough to pass through a canal lock, and in order to make the platform, on which the horses travel, of sufficient size, a segment of the circle, called a wing, is hinged on each side to the scow, so that in passing through a canal lock, or any other narrow place, the wings may be turned up. The scoop is to be worked by two barrels, or drums, placed one at the top, and the other at the bottom, of a vertical shaft, in the middle of the platform—these drums are, alternately, thrown in and out of gear by means of a vertical sliding bolt, and a horizontal lever, worked by the attendant. The chain that draws up the scoop passes around a roller at the end of the machine, and thence around the barrel at the top of the shaft, and that which draws it down and back, passes under the platform, and winds on the lower barrel.

The scoop is attached by one of its sides to two long guide poles, that slide in loops made in two collars, turning loosely on the ends of a horizontal windlass, which forms the axis around which the scoop swings, when drawn up or let down. In letting down the scoop, the chain which is attached to its bottom, is drawn in by throw-

ing the lower barrel into gear; this causes the guide poles of the scoop to slide in the loops, which brings it near to the windlass, and after it has passed a vertical line its gravity causes it to sink. The lower barrel is then thrown out of, and the upper into, gear; by this the scoop is drawn along the bottom, and filled, and then, with its load, is drawn up out of water. The stuff raised is discharged from it into a scow, or other receptacle, by pulling a rope, or chain, which disengages a spring catch, by which the hinged bottom is fastened. The bottom is closed as the scoop strikes the water, in the operation of being drawn down to be re-filled. The distance to which the scoop descends below the windlass, around which it works, is regulated by a chain, which winds around it, and is attached to a brace connecting the two guide poles together, near the scoop.

Claim—"What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the barrels on the perpendicular shaft, for winding and unwinding the main chains, in combination with the vertical sliding bolt and lever, for throwing the barrels in, and out of, gear, with the shaft, by which the scoop, or bucket, is alternately raised, lowered, and drawn back, whilst the animal, by which the main shaft is turned, continues to travel on the circular tracks without interruption." Also the combination and arrangement of the parallel guide poles, chains, and windlass, for raising the scoop, so as to draw it back to its proper position, as described;" and this I also claim in combination with the scoop and the apparatus for "disengaging the drop, or shutter, to discharge the load, as described." I also claim "the arrangement of the wings of the horse track, which can be raised, and thereby reduce the width of the machine, so that it may pass through a canal lock, or any other narrow place, as described."

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18. For *Conducting Grain and Straw after it has been Thrashed;* Luther Whitman, Winthrop, Kennebeck county, Maine, August 25.

The general principle of this machine does not present any thing new, and the claim has, therefore, been confined to the peculiar arrangement of the parts. Slats of wood are attached, edgewise, to two chains, which pass around two rollers. The belt, or chain, of slats thus formed, slides on an inclined board, so that the slats form the sides, and the inclined board the bottom, of a series of cells. One of the rollers around which this belt works, is placed under the thrashing cylinder, and the other roller is placed near the elevated end of the inclined board, at the back part of the machine. As the straw and grain are thrown out by the thrasher, the former falls on the top of the slats, and the latter passes into cells formed by the slats, and by the inclined board, on which they are sustained, and the straw and grain are thus carried up, and the former is discharged on to another belt of slats, called the carrier, which conveys it off to a distance, while the grain falls on a board, which conducts it to the fanning machine.

Claim.—"What I claim as my improvement, and for which I ask

an exclusive right, is the combination of the endless belt of slats, constructed as herein described, with the inclined board and straw carrier, the whole being so arranged that the belt, while it conveys the straw from the thrasher, carries the grain also with it up the inclined plane, in the manner described."

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19. For improvements in the *Machine for Planting Corn and other Seeds;* Samuel W. Cole, Chelsea, Suffolk county, Massachusetts, August 25.

This machine is a modification of that kind of seed planter in which the seeds are taken from the hopper and carried around to a dropping tube, by a wheel, with cavities made in its periphery; the improvement consists simply in making the cavities in separate pieces, which fit into receptacles made for that purpose, in the wheel, so that pieces with different sized cavities may be employed at pleasure for different kinds of seed.

The claim is, first to "constructing the dropping cylinder with changeable slides, and forming receptacles in the same for receiving the seed from the hopper; also the mode of adapting the lower part of the hopper to the apertures in the end of the slides, by forming it with chutes, in the manner set forth, so as to better conduct the seed to the receptacles in the slides, the whole being arranged, and operating substantially, as above described." Second, I claim the mode of compressing, or regulating, the "stiffness of the brush (which makes a part of the hopper,) by means of the clamp and screw, in combination with the hopper and dropping cylinder."

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20. For a *Cooking Stove;* Samuel W. Cole, Chelsea, Suffolk county, Massachusetts, August 25.

This stove is circular—the fire-chamber, which is conical, and provided with a grate at the bottom, is placed in the centre, thus leaving a baking-chamber all around. The fuel is fed in at the top, through an opening in an elevated cap, which opening may be closed by a boiler, or by a cover. The pipe which leads to the chimney passes out from the cap.

The fire-chamber is surrounded by a cylindrical tube, which extends from the lower part nearly to the top of the baking-chamber—at the top it is in contact with the fire-chamber, and as one of these is conical, and the other cylindrical, there will be a space between the two, reaching from the part where they touch, to the bottom; the object of this arrangement is fully explained in the claim. The cylindrical tube is surrounded by a circular perforated shelf, supported on screw rods, which pass through the bottom plate, to regulate the height of the shelf.

Claim.—"I claim the particular mode of adapting the circular shelf to the oven, and adjusting the same by means of screws passing through the bottom plate, also the furnace constructed with an exterior casing, or cylinder, for the purpose of causing the heat radiating from the outer surface of the furnace to pass downwards, and escape

near the bottom of the oven, thereby causing it to be first distributed under the rising shelf, at whatever height the same may be in the oven, the whole being arranged and operating substantially, in the manner, and for the purpose above described." I claim the combination of "the circular shelf with the oven and furnace, the furnace being so arranged in the oven that the shelf shall entirely surround it."

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21. For a *Machine for Planting and Sowing Seeds;* Joseph Gibbons, Adrian, Lenawee county, Michigan, August 25.

The hopper of this machine is made of any desired length to correspond with the number of rows intended to be planted at the same time, and is divided into sections by partitions running across it, each division having a corresponding dropping tube. Below the hopper the machine is crossed by a roller provided with cavities, to receive and carry around the seeds, or plaster; the capacity of these is regulated by a tube of tin, or other metal, that surrounds the roller, and may be made to revolve thereon to a small distance; this tube is provided with apertures, which correspond with the cavities in the roller, and one edge of the metal forming each aperture is turned down into the corresponding cavity in the roller, and reaches to the bottom of it, so that by turning one on the other the capacity of the cavities may be enlarged, or diminished; a roller runs across the machine at the rear part of it, by which roller the rows are to be covered; and when it is desired to stop the seed roller the operator bears upon the handle at the back, which lifts the wheels that operate it from the ground.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I regulate the capacity of the cavities made for receiving and carrying the seed to be planted, or sown, by surrounding the roller in which said cavities are made, by a tubular casing, adapted thereto in the manner described." "I also claim the manner of constructing and using said machine, so that by bearing upon the handle, or handles, at the back part thereof, the roller will operate as a fulcrum, and the distribution of the seed will be arrested."

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22. For a *Card Printing Press;* Samuel Orcutt, Boston, Massachusetts, August 25.

The following is the claim upon which this patent was granted, viz. "What I claim as constituting my improvements, and desire to secure by letters patent, is first, the manner in which I have connected and combined the lever and toggle with the frisket, the inking drum and inking rollers, so that by the depression and elevation of said levers, the frisket shall be carried under the platten, the inking apparatus being brought into operation, and the frisket moved out after the impression has been made, all as herein set forth." Secondly, I claim the general arrangement "of the respective parts of the frisket for holding the card, in combination with apparatus for dropping the card, by withdrawing the parts upon which it is supported, by means

of the angular catches, or triggers, and their appendages. The other parts described I do not claim; as many, if not all of them, have been previously used in other forms."

We could not, within the limits allotted to a single notice, make the character of these improvements more clear than is done in the above claim, without giving drawings, by which the patent is accompanied.

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23. For *Puddling Furnaces for Manufacturing Iron;* Thomas Cooper, City of New York, August 25.

The patentee says—"The nature of my invention consists in providing a reverberatory furnace with a hearth, space, or dead work, around the grate, or fire-bars, by which the brick work of the fire-chamber is protected from intense heat, and from which the clinker is easily removed. With a vertically descending flue when applied to puddling, scrapping, bitteting, or heating iron with anthracite coal; and in the combination of two, or more, heating bottoms and fire-chambers in one furnace." The grate is made in the middle of the chamber of combustion, or the receptacle for the coal, with dead brick work all around, on which the coal, not fully ignited, rests, and the flue on the side of the heating, or puddling chamber, opposite the chamber of combustion, descends, and then passes out, horizontally, to the chimney. The descending flue, when two heating chambers are employed, is used for the draft of the two chambers of combustion.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the floor, or bottom of the fire-chamber, with a grate in the centre, as set forth, surrounded by a dead work for protecting the brick work of the chamber, as described." "Also constructing the furnace with a vertical descending flue, in the manner, and for the purpose set forth." "Lastly, I claim combining two, or more, furnaces, constructed with grates and dead work, and having a descending flue, all as described."

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24. For an improvement in the *Franklin Cooking Stove;* Reuben B. Houghton, Clarkson, Monroe county, New York, August 25.

The back plate of the fire-place in this stove, instead of running up, as usual, rises only a few inches, and just above the upper edge of it a square shaft extends from side to side of the stove, and passing through one of the side plates is provided with a winch by which to turn it round—from one of the sides of this shaft grate bars project, and from a contiguous side, a flat plate extends at right angles to the grate bars. Between the back plate of the fire-place and the front plate of the oven, there is another plate, extending nearly as high as the top of the oven, with a flue between it and the oven; and the side plate of the stove is provided with an opening, and door to correspond to the space between it and the back plate. By this arrangement the fire may be situated nearer to, or further from, the oven. When the shaft is so turned as that the grate bars lie horizontally, the fire is sustained on the grate, and the dead plate stands at right angles

thereto, and forms the back of the fire-place; and when it is turned, so as to have the grate bars vertical, the plate lies horizontally, and it, together with the grate and the second back plate, constitute a box stove, which is supplied with fuel through the door at the side. Two valves are used to regulate and give proper direction to the draft. The claim is limited to the combination of the "turning grate" with the vertical plate and dampers.

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25. For an *Electro-Magnetic Machine* to obtain a Moving Force for driving Machinery; Truman Cook, New York City, August 25.

The following extract from the specification will give a pretty accurate idea of the invention. "Having thus fully described the manner in which I construct my electro-magnet apparatus, and likewise the manner of making the improved galvanic trough for actuating the same, what I claim therein as constituting my invention, and desire to secure by letters patent, is first, the arranging of the armatures upon a cylinder, or drum, in combination with the pairs of electro-magnets so situated as that the negative and positive pole of each individual magnet shall, at the same moment, be over two contiguous armatures, in the manner herein set forth." "Secondly, I claim the mode of interrupting the galvanic circuit by means of the cams, or notches, on the axis of the cylinder operating the wires which dip into the cups of mercury, as set forth, in combination with the stationary magnets and revolving armatures, arranged and constructed as herein described." "Lastly, I claim the galvanic battery herein described, composed of separate and distinct plates, communicating with cups of mercury, in the manner described, in combination with the electro-magnetic apparatus, consisting of stationary magnets and revolving armatures, as described."

At the period when this patent was obtained, a machine of considerable size had been built, for the purpose of driving the propelling apparatus of a boat; not having heard of the result of the experiment, we are compelled to infer that there is one more to be added to the list of unsuccessful attempts in the employment of the electro-magnetic power as a substitute for steam.

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26. For improvements in the *Machine for Carding, or Picking, Curled Hair;* Francis Harding, Cleveland, Cayuhoga county, Ohio, August 25.

Upon a cylinder about two feet in diameter, and similar to the cylinder of a carding machine, slats are attached, which are about two inches in width, and four inches apart—these slats are covered with cards having two or three rows of strong wire teeth set in stout leather, and bent, or hooked, forward. Over the cylinder, attached to arch pieces, are six stationary slats, provided with teeth similar to those on the cylinder, but with the hooks turned the reversed way. These slats are connected with the arch pieces by means of springs, so as to give them some play; the teeth on these slats are of the same kind as those on the cylinder, but they are less and less coarse as they recede

from the feed apron and approach a brush cylinder, which is opposite a feed apron, by which the machine is supplied.

The claim is to the combination of the stationary and revolving cards, arranged, constructed, and operating as described, and in combination therewith the revolving cylinder of brushes, each brush consisting of a single row of bristles.

The difference between this machine and the carding, or heckling, machines, previously in use, will be manifest from the fact that neither of these machines would perform the operation of picking curled hair; whatever similarity there may be between them, it must be plain that they are by no means identical.

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27. For an improvement in *Chairs;* Matthew W. Ring, New York City, August 25.

The seat of this chair is jointed to a bottom plate so as to rock on it, and the rocking is relieved by spiral springs placed between the seat and plate, towards the front and back edges thereof. The covering around the edges, which unite the rocking to the permanent part of the bottom, is put on so as to give full play to the seat. The bottom plate is connected to the pedestal by a pivot, similar to that used in the stools of piano fortes; and the back and arms are formed of metallic rods, bent in the proper shape, to render them easy and flexible.

Claim.—"I do not claim to have invented the before described separate parts of the revolving accommodating seat, but what I do claim as my invention, and wish to secure by letters patent, is the combination of the revolving with the jointed spring seat, as before described." "I also claim the mode of making the spring back and arms, by means of metallic spring bars, or rods, as described."

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28. For a *Cotton Press;* Fowler M. Ray, Catskill, Greene county, New York, August 25.

In this press the follower is forced upwards, and this is effected by the aid of two ropes, or chains, one attached to each end of the follower, and passing thence over a pulley, and having its outer end attached to an arm projecting from a shaft, at right angles thereto. A snail, or fusee, wheel is attached to one end of the shaft, and from this a rope passes to a capstan. When the follower of the press is down, the arms to which the ropes are attached, are horizontal, and the rope from the capstan acts upon the smallest part of the snail wheel, hence the motion of the follower will be rapid, the resistance to its upward motion being at that time small; but as the resistance increases the power of the levers, formed by the arms, gradually increase until the rope winds upon the shaft from which they proceed, and at the same time the snail wheel is also lengthening its purchase, so that at the time the follower meets with its greatest resistance the power applied has also reached its highest point.

This arrangement constitutes a very simple and efficient mode of applying a progressively increasing power to a press.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the using of the arms, projecting at right angles from the shaft, and having ropes, or chains, attached to them, which pass over pulleys, and raise the follower of the press; the respective parts being combined, connected, and operating substantially as herein set forth." "I do not claim the manner of constructing and applying the capstan and windlass to my press, although I believe that there is novelty in their mode of construction and operation; nor do I claim any of the other parts described, when taken alone, but I limit my claim, as above, to what I consider to be the distinguishing feature of my press; and this part, or arrangement of parts, I claim, whether constructed precisely in the form and manner described, or in any other which is substantially the same."

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29. For a *Mill for Grinding Apples, or other Fruit;* Thomas J. Wells, New York City, August 25.

The crushing, or grinding, is effected by two disks, whose surfaces are very flat cones, each of them attached to the end of a shaft, and the axes of the shafts are placed at an angle to each other, equal to the angle formed by the cone with its base, so that when the two disks are brought together, one side of the cone of one disk will touch, or nearly touch, one side of the opposite disk, whilst the other portions of their surfaces will be separated. The shaft of one of the disks slides in its bearings, and is pressed up to the other by a weighted lever. A hopper is so placed as to feed the apples, &c., between that part of the disks which are separated.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode above described, of crushing apples, or other fruit, by the action and combination of the two conical disks combined with the lever and pulley."

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30. For an improved *Elevated Oven for Cooking Stoves;* J. P. Williston, and Willard A. Arnold, Northampton, Hampshire county, Massachusetts, August 25.

The following extracts from the specification will be found to give a very clear idea of the improvement. "In elevated ovens heretofore constructed, the body of the oven has been formed of two cylinders of unequal diameter, one of which is placed within the other, at an equal distance, both at the bottom and sides, from the outside cylinder, thus constituting a flue, into which the heated air and smoke are allowed to enter at the bottom, through two, or more, pipes, and to escape from the top through a pipe leading into the chimney."

"It has been found, by experience, that with an oven so constructed, a much larger fire is required to bake in the oven, than is necessary for doing the ordinary work of the stove to which it is attached."

"This objection to elevated ovens we have obviated, by enlarging at the bottom the space between the interior and exterior cases, of which the oven is formed, and narrowing it upon its sides and top."

"What we claim, is the enlarging of the capacity of the flue which

surrounds the oven, at its lower side, and diminishing it on its sides and top, in the manner, and for the purpose described."

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31. For a *Process for Tanning Leather;* Abel H. Buzzell, Bridgeton, Cumberland county, Maine, August 25.

The patentee says—"The nature of my invention consists in raising the hide by the aid of sulphuric acid, (oil of vitriol of the shops,) and when raised sufficiently, so changing the same with tannin that it will not return to its original condition. Then suspending wood ashes, contained in sacks, in the pits, to destroy the compound which is formed by the tannin and sulphuric acid, and which prevents the gelatin of the hide from uniting with the tannin. This method renders the use of the acid, to any desirable or necessary extent, perfectly safe; shortening the period for tanning, and increasing (by means of the acid,) the capacity of the hide for receiving tannin, and adding much to the quality of the leather."

"What I claim in the above process as my invention, and desire to secure by letters patent, is the mode of tanning hides, by placing them, when raised, in a decoction, or solution, of bark, or other liquor containing tannin, and after they have remained there a suitable time, as herein specified, adding an alkali to the liquor, as herein set forth."

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32. For an improvement in the *Lamp for Burning Camphine;* Michael B. Dyott, City of Philadelphia, August 25.

This improvement is described as applied to that kind of lamp formed by the union of two cones, with three inclined burners projecting therefrom. The improvement consists of a plate which rests upon three, or more, screws, by which its height is regulated; this plate is perforated with three holes, through which the upper part of the wicks and flame pass, and as they are larger than the burner, they admit the necessary and desired supply of air, which supply may be regulated at pleasure, by turning the screws on which the plate rests.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is not any exact proportion, or number of burners, or the particular mode of disposing, or placing, them in any peculiar form, or situation; but I claim the mode described, of regulating the draught by means of a movable plate, which sustains the glass chimney, and otherwise being constructed and operating as set forth, and described in the above specification."

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33. For an apparatus for *Obtaining Casts from the Teeth and Gums, and for Adjusting the Casts when taken;* Daniel T. Evans, City of Philadelphia, August 28.

The patentee says—"This apparatus consists in an improved mouth mould, which is to be filled with wax, that a perfect impression of the teeth and gums may be taken by allowing the jaws to close upon it; after which, the impression so made, is to be filled with plaster of paris, and this, whilst in a soft state, is to be placed between plates of

metal, in an instrument made to open and close in the manner of the mouth; a portion of the plaster being placed upon said metallic plates, for the purpose of attaching the two portions of the cast thereto."

"I claim as my invention—First, the manner of constructing the mouth mould without a dividing plate, so as to admit of the meeting of the teeth, and of their lapping over each other in taking the impression, as set forth." "Secondly, I claim the manner of constructing and combining the apparatus of plates for receiving and holding the casts, in plaster from the teeth and gums; said apparatus being furnished with a movable plate, the action of which is similar to that of the lower jaw in the living subject."

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34. For an improved *Process for Manufacturing White Lead;* Smith Gardiner, New York, August 28.

(See specification, p. 123, vol. 26, 2nd series.)

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35. For a machine for *Hulling Rice;* Warren Groat, Troy, Rensselaer county, New York, August 28.

The patentee says—"The nature of my improvement consists principally in the construction and application of machinery by which the grain is made to pass between the surface of one body in motion and another at rest, or both in motion at different velocities, or in contrary directions. The one being hard and rough, and the other, yielding and elastic, so that under the regulated pressure for which provision is made, as will be shown in the description, their co-operation will give to the grain the action required, and at the same time allow it to pass without being unnecessarily broken by the process."

"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing a cylindrical surface of files, or of stone, and a yielding and elastic surface, or bed, made by the union of caoutchouc and leather, and employing the said cylinder and bed in connexion, or co-operation with each other, in the manner, and for the purpose above described. And also the placing of files at discretion, between different sections of such elastic bed, and using the same in like connexion with the cylinder, for like purposes, as also above described."

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36. For a *Steam Boiler and Generator;* Dudley Marvin and Oran W. Seely, the former of the city of New York, and the latter of Sodus, Wayne county, New York, August 28.

This patent is obtained for a boiler for generating steam for the purpose of steaming and cooking articles of various kinds. The sides and back end which surround the fire chamber are double, and contain water, and the part of the boiler which is over the fire chamber, consists of water cells, which run from front to back, leaving spaces between for the circulation of the draught of heated air. Division pieces running horizontally from the front nearly to the back, divide the spaces between the cells into two compartments or flues. The

heat impinges on the bottom and sides of the cells, and circulates around the ends of the division pieces, along over them, and out at the chimney flue, which is in front, above the feeding door. The steam is carried off by pipes from the steam chamber to any place desired. The whole boiler is composed of seven parts, so formed as that they may each be moulded and cast in one piece, without the use of cores.

Claim.—"We claim first, the manner in which we have constructed and combined the respective parts of our boiler, or steam generator, with each other, as described; that is to say, we claim the formation of the water cells, consisting of one which surrounds the three sides of what we have denominated the principal casting, extending down to the lower edge of said casting, and having three, or any preferred number of water cells, intermediate between the cells at the sides of the principal casting, said intermediate cells extending down so far as to leave the requisite space for the fire chamber, and having spaces between them, which are to be converted into reverberating flues, by means of partition or division pieces, located and operating in the manner herein set forth. We claim, secondly, the forming or making of that part which we have denominated the principal casting, in one single piece of cast iron, by giving to the respective parts thereof, the designated taper, and otherwise constructing the pattern, in the way described, so that it will draw from the mould, and may be cast in a single pair of flasks, without the employment of cores."

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37. For a *Machine for tarring Shivers or Bands of Hemp, and making Oakum of the same;* William Montgomery, Boston, Massachusetts, August 28.

The patentee says—"The object of my invention is to prepare oakum from the Cordilla hemp or tow (sometimes so called) which is of much poorer quality than the Russian hemp; and inasmuch as the fibres of the former are shorter than those of the latter, though equally sound and new, and sufficiently good, for the above mentioned purpose, as it produces a better quality of oakum than that obtained in the manner now practiced from the tarred rope and yarns. Another object of my invention, is to prepare the oakum in a proper roving, or shiver, so that without any further preparation, than that of being properly dried after passing through the operation of my machinery, it can be applied to its purpose of caulking the seams of vessels, &c."

The shiver of hemp is passed between two rollers, and around a reel which revolves in tar, and is provided with radial arms and guides, by which the shivers on the reel are pushed towards one side to make room for the shiver, which is constantly rolling on. After the shivers are taken from the reel, they are passed between two sets of rollers, the first of which press out the surplus tar, and the others being draw-rollers, separate and draw out the fibres, and supersede the necessity of picking. There are weighted, curved guides and rods, which prevent the tar from gathering in lumps, as the shivers

pass through the pressing rollers. We omit the claim, as it refers throughout to the drawings.

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38. For *Heating the Blast of Smelting Furnaces;* William H. Phillips, Brooklyn, New York, August 28.

(See specification.)

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39. For a *Composition for rendering Leather Water-proof;* Charles F. Miller, city of Baltimore, Maryland, August 28.

The ingredients which form this compound, consist of one part of beeswax, one part of spermaceti, one part of rosin, half a part of suet, half a part of hog's lard, and a quarter of a part of borax. The borax is pulverized, and put into a vessel with the other ingredients, and melted over a slow fire. The mixture is to be put on the flesh side of the leather, at a tepid heat, and the application repeated, until it appears on the grain side—it is then suspended in an oven. After it is taken from the oven, it is rendered smooth in the usual way, by rubbing and bending. It is then rubbed on the flesh side with armenian bole, or red chalk.

Claim.—"What I claim is the particular compound, composed of the materials, and combined in the proportions, or nearly in the proportions, above set forth. And I also claim the manner of applying this compound, and preparing the leather for use, by exposing said leather in an oven, properly heated, in the manner, and for the purpose, herein made known, in combination with the subsequent process of filling the pores on the flesh side, with armenian bole, or other absorbent earthy matter possessed of analogous properties.

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39. For a *Molasses Gate;* Ammi West, Greene, Kennebec county, Maine, August 28.

The forward part of the tube, or body of the faucet, is made conical, the larger part being towards the cask; a conical cap fits and revolves on it. The two are kept tight by means of a screw, which passes through the end of the cap, and screws into the tube or body. A hole is made in each, through which the molasses is discharged, when they coincide, but when the cap is turned on the body, or tube, its flow is cut off.

Claim.—"What I claim as my invention, is the mode herein described, of tightening the cap upon the inner tube, by making them of a tapering or conical form, and connecting them by a screw, in the manner set forth, so that when the cap is screwed down upon the inner tube, it shall, owing to the conical form I have given the cap and tube, be made to embrace the latter more closely, and thus prevent leakage as the parts wear away."

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40. For an *Improvement in Saw-Mill Dogs;* Martin Rich, Ithaca, Tioga county, New York, August 28.

These improvements consist in a peculiar mode of constructing the

dogs—in operating the slides by means of two endless screws on the same shaft—in a combination and arrangement of parts, by which the log is set by the motion of the carriage—and in the peculiar manner of constructing the rack which sets the log.

The dogs are made of a quadrangular frame of iron, with teeth on one side; this frame slides in a mortise made for that purpose, in an iron standard, which slides in the head block. The dogs are retained in place, after being driven into the log by a screw or wedge at the top.

A shaft runs across the head-block, with two endless screws, one on each side of the kerf, which take into a rack on each of the slides which carry the dogs. The outer end of the shaft has a cog wheel, the cogs of which take into cogs on a rack, attached to a vibrating bar, for throwing the rack in and out of gear, by which the log is set. The cogs on this rack are movable, and the number of them will regulate the thickness of the set which will be given to the log.

Claim.—"What I claim as my invention is, first, the manner in which I have constructed and arranged the improved dog, as set forth, namely, the giving to it the form of a triangular frame, furnished with teeth on one side, and sliding through an opening, or mortise, in a standard affixed to, or making a part of, a sliding plate and rack, by which the log is carried in setting; said dog being held in the required position by a screw, or wedge. I claim, secondly, the arrangement and combination of the parts concerned in the setting of the log, by the return motion of the carriage: said combination consisting of the shaft, with its right and left handed screws; the cog wheel on its end, and the vibrating bar for throwing the rack into and out of gear. I claim, thirdly, in combination with the log setting apparatus, the manner of constructing the rack with movable teeth, for the purpose described."

Specifications of American Patents.

Specification of a Patent for an Improved Mode of Constructing the Packing for Pistons, &c. of Steam Engines. Granted to Charles F. Pike, *of Providence, Rhode Island, August 12th,* 1840.

To all to whom these presents shall come: Be it known that I, Charles F. Pike, of the City of Providence, in the county of Providence, and State of Rhode Island, have invented a new and improved mode of constructing the packing of pistons, piston rods, and valve stems, and I do hereby declare that the following is a full and exact description of the same.

The nature of my invention consists in the use of cylindrical metallic wedges, within side of metallic rings when used for the packing of pistons; and without side of metallic rings when used for the packing of piston rods, or valve stems.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation. I construct

my packing for steam engines, or other pistons, by making two rings of cast iron, or other metal, turned as large as the diameter of the cylinder, and so wide that the rings will just fill the space between the head and follower of the piston when ground together. I saw said rings open, so that they may expand to fill the cylinder. I make a cylindrical wedge as wide as the two rings afore-mentioned, the external diameter of which will just admit it to slide within the aforementioned two rings when they are placed in the cylinder. The internal diameter of said wedges being conical, and as much larger at one end than at the other, as may be deemed necessary, said wedges being cut longitudinally into four, or more, parts, so that each part may be forced out from the centre against the two rings afore-mentioned. I make another cylindrical wedge in the form of the frustum of a cone, and about seven-tenths as long as the one last named, the external diameter and taper of which corresponds with, and fits into the internal diameter of the large end of the other, the thickness of which I make sufficient to admit of screws being tapped into it, to move it longitudinally on the barrel of the piston. To keep said wedge in its place, I put in four, or more, screws, with collars on them, to be let into the followers, two on one side, and two on the other. Two with the collars on the inside shove the wedge ahead, and the other two hold it, or draw it, back. I construct my packing for piston rods, &c., by making two rings of brass, or other metal, of a diameter that will just admit them on the rod, and so wide as just to fill the space between the bottom, or the bushing, and the cap, when ground together, and of a thickness of about one-eighth of the diameter of the piston rod, which I cut open, and place on the rod, so as to break joints. I make a cylindrical wedge of a width and internal diameter, corresponding with the width and external diameter of the two rings aforementioned. I make said wedge thicker at one end than at the other, to give it the proper taper, and cut it longitudinally, into four, or more, parts, so that each part may be forced in towards the centre against the two rings afore-mentioned. I make another cylindrical wedge about seven-tenths as wide as the last named, the internal diameter and taper of which corresponds with, and fits on the external diameter of the small end of the other. The thick end I make of a proper thickness to admit of four set screws, made in the same manner as described for the piston, the external diameter of which is the same as the internal diameter of the head, or stuffing box; I fit on a cap with set screws therein, to adjust the last named wedge, so as to keep the two rings snug to the rod.

Having thus fully described the manner in which I construct and arrange the respective parts of my metallic packing, what I claim therein, and desire to secure by letters patent, is the within described manner of packing the piston of a steam engine by the combined action of the conical wedge operating upon the sectional wedges, and these upon the divided rings, the conical wedge being adjusted by set screws, the whole being constructed and operating substantially as set forth.

I also claim the employment of divided rings to constitute the pack-

ing of a piston, these having been before used, but under an arrangement of the necessary parts, essentially different from that employed by me.

I also claim the packing of piston rods, and of valve stems, by an arrangement of the respective parts constituting the packing, similar to that employed in the packing of pistons, but situated in a reversed order, the divided rings embracing the piston rods, or valve stems, as above made known. CHARLES F. PIKE.

Specification of a Patent for an Improved Apparatus for Heating the Blast of Smelting Furnaces. Granted to WILLIAM H. PHILLIPS, *of Brooklyn, New York, on the 28th of August,* 1840.

To all whom it may concern: Be it known that I, William H. Phillips, of the City of Brooklyn, in the State of New York, have invented a new and useful improvement in the manner of heating the air to supply the blast in those smelting furnaces in which mineral coal is used, and in which there is an air-heating apparatus at the tunnel head; and I do hereby declare that the following is a full and exact description thereof.

For the purpose of economizing fuel, it is a point of considerable importance to be able to use the waste heat for supplying the blast to the smelting furnace, and this has been done in numerous instances, and under various modifications of the apparatus employed. It has been found, however, that in all cases, the air so heated, is subjected to great variation in its temperature, and that from causes incident to the employment of such furnaces when dependence is had upon the waste heat alone to accomplish the intended purpose. Whatever produces a diminution of heat in the interior of the furnace must produce a corresponding effect in the air-heating apparatus, and that at a time when it is most desirable to keep up, or increase, the temperature of the hot blast, in order the more rapidly to restore the wanted temperature in the furnace. One of the most general causes of the temporary diminution of heat in the furnace is the introduction of the charges of coal, ore, and flux. The quantity of gas emitted from the fuel also varies considerably in different stages of its combustion, and with it, of course, the quantity of flame in the heating apparatus; other sources of such variation of heat are well known to those conversant with the use of smelting furnaces. My improvement is intended to, and does, effectually, obviate this difficulty, and that in the following manner.

On the sides of, or otherwise close to, the heating apparatus on the tunnel head, I place one, two, or more, small furnaces, for the express purpose of heating a portion of air which is to pass from them into the heating oven, and to co-mingle with that arising through the chimney of the smelting furnace. To these auxiliary furnaces I make close fitting doors, in order that no air shall pass into them, excepting that which is forced to pass through the burning fuel which they are

Into the ash-pit of these auxiliary furnaces I introduce a pipe, through which air, either hot, or cold, may be blown from any suitable part of the blowing apparatus, which, by passing through the ignited fuel, and thence directly into the heating oven, may be made to communicate a very high degree of heat to the pipes contained therein; I of course regulate the supply of air to be blown into the heating oven, and to pass from the blowing apparatus into the auxiliary furnaces, by means of cocks, valves, or dampers, applied in the ordinary way, which devices are well known to all machinists.

Having thus made known the nature of my invention, and shown the manner in which the same may be carried into operation, what I claim therein as constituting my improvement, and desire to secure by letters patent, is the combining with the ordinary air-heating apparatus, on the tunnel head of a blast furnace for smelting iron, by means of mineral coal, one, two, or more, small auxiliary furnaces, into the ash-pits of which air is to be blown, and to be heated by passing through ignited coal, and thence conducted immediately into the heating oven; the whole being connected and combined substantially in the manner, and for the purpose, above set forth.

I will here remark, that when it is not requisite to employ the heat from the auxiliary furnace, or furnaces, by closing the valves in the passages leading into, and from them, the contained fuel will merely remain ignited, scarcely undergoing any combustion, until urged by the blast.

WILLIAM H. PHILLIPS.

Progress of Physical Science.

Notes and Diagrams, illustrative of the Directions of the Forces acting at and near the surface of the Earth, in different parts of the Brunswick Tornado, of June 19th, 1835. By A. D. BACHE, *Professor of Natural Philosophy and Chemistry, in the University of Pennsylvania; one of the Secretaries of the American Philosophical Society. Read April 2d,* 1836.*

IN company with my friend, Mr. Espy, I visited, in the early part of July last, the scene of the destructive tornado of June 19th, the ravages of which had been most severely felt in New Brunswick, New Jersey, and its vicinity; the effects extending about seven and a half miles to the west, and ten to the east of that place. The idea of illustrating these effects by the aid of instrumental means, first occurred to me after hearing an interesting account by Professor Johnson, before the Academy of Natural Sciences of this city, of an examination made by Professor Henry and himself, of the position of materials carried by the storm from the city of Brunswick, and deposited in a field on the opposite bank of the river Raritan.

* The views of Mr. Redfield in reference to this tornado having been recently published in this Journal, it is deemed proper to re-publish the article of Prof. Bache.—COM. PUB.

The regularity in the general arrangement of these materials, gave me the hope that further facts of interest might be brought to light by an examination of the country along the path, and fully established, as well as clearly represented to the eye, by diagrams laid down from actual measurement.

To this point I devoted exclusive attention during the limited time which a very brief recess from duty at the University afforded me. Mr. Espy collected at the same time the accounts of those who had witnessed the phenomenon, examined closely the general circumstances, and is equally concerned with myself in any claim to novelty in the results about to be submitted. As he will embody the deductions from the information collected, and from the general observations which we made, I do not propose to go into them further than is necessary to make my results intelligible.

The accompanying diagrams, plates III, IV, represent different portions of the track of the storm, from the point at which its effects were first felt in any considerable degree, to a point about a mile east from Brunswick, where I was reluctantly obliged to close my observations.

They were obtained by means which, though rough, are abundantly exact for such a purpose, namely, by measuring the angles to be taken, by the compass, and by pacing the short distances to be estimated.

Such an examination being made of the track of the tornado through a wood, or in any other suitable case, the directions of the acting forces are determined, and thus is ascertained whether they correspond to the effect of a whirl, at and near the surface of the ground, as is generally assumed, or to that of a rushing wind, or, as most fully appears, to that of a mighty column of rarefied air in motion.

Although the action of the storm on buildings, affords many interesting facts in regard to the phenomenon, and in one case, an effect of great interest was thus first pointed out; yet, as we expected, the most satisfactory evidences of the directions of the forces occur, generally, in open woods, and in the plantations near buildings.

It may seem superfluous to a reader accustomed to observation to say, that entire regularity is not to be looked for in the effects to be brought before him. I have, however, thought it best to remark briefly upon some of the causes which might be expected to produce considerable irregularities, in the positions of trees overthrown, or broken, by the storm.

The soil of the part of New Jersey through which this storm passed is a red clay, (from the red shale,) and deficient in strength. The trees growing upon it extend their roots very far horizontally, while they penetrate but a short distance below the surface. They are, therefore, readily uprooted, and in the overthrow, carry a considerable extent of soil with them.

If the forces acting during the whole period that the trees were within the sphere of action of the storm, be supposed of equal intensity but varying direction, then the trees extending their roots un-

equally in different directions, will oppose unequal resistances in those directions, and two trees side by side may be thrown different ways. Several trees presenting thus a want of conformity of direction, would induce, at first view, the idea of a total want of regularity calculated to baffle observation. If the forces vary in intensity as well as in direction, this difficulty will be increased. Again, the circumstances of the proximity of other trees, may not only influence the direction in which a tree will fall, after its motion has commenced, but the very direction in which the force producing its fall may act. And these remarks apply in even greater force to the case in which trees are broken, instead of being overthrown.

The unequal strength of parts of a building, and its protection by adjacent buildings, must produce difficulties of a similar kind; while in the trees near to houses we should look for even more irregularities of direction, than in those in an open wood.

These remarks, it will be seen, are not intended to set aside any cases which may appear inapplicable to a general conclusion, but merely to guard against unreasonable requirements.

Of the diagrams, figures 1, 4, 5, and 7, are drawn to the same scale; the scale of figures 3 and 6 are attached to them respectively; and figure 2 is not drawn to a scale.

The directions of the trunks of trees are represented in all but figure 1 by arrows. In order to make these directions appear distinctly, these arrows are out of proportion to the horizontal distances between the trees. This causes the tops of trees to appear very near, which, in many cases, were not so.

The first point to which we traced the action of the storm, was near the farm of Mr. M. S. Garretson, about seven miles, a little south of west, from New Brunswick. It crossed the Millstone river, and the Trenton and Brunswick canal, about half a mile to the west of Mr. Garretson's dwelling, and its track was between this house and a barn about sixty yards from it. A small portion of a light fence, and some other matters, were carried across the road upon which the house fronts, and a part of the trees in an orchard thrown down. Neither the barn nor dwelling house was injured, and the action was described as that of a strong wind of limited breadth. In the orchard, the trees to the south of the path of the storm, were thrown northwardly, and those to the north, southwardly. Passing on to the east, the next effect was seen in overthrowing a large cherry tree, and carrying off the southwest corner of the thatched roof of a small saw-mill. The most violent action, however, at this place, was upon a wood nearly east from the dwelling house, and is shown in the sketch figure 1, plate III. This is, perhaps, the most hasty of all the determinations which I made, as the interest which attached to the effects wanted the force of novelty: they being similar to those referred to, as observed by Professors Henry and Johnson. The ground represented in the diagram is irregular, consisting of a hill, the sides of which are covered by wood; the hill being cut by a ravine which was apparently near the northern border of the storm, or of that part in which the trees were thrown in the direction of its course. The

wood was of young hickories and black oaks, without undergrowth, but even here some irregularities were seen. The spiral growth of a few of the trees had led the proprietor of the farm to think, and speak, of the whole effects as produced by a whirlwind. He pointed out those cases, which were, obviously, seen to have resulted from the cause which I have just assigned. It will be observed in the figure, that of nine trees there represented, the two on the north side of the storm fell southward and eastward, one, *g*, points out its direction nearly, and five of the six of the south side are directed between N. 10° E., and E. 40° N. The breadth of the storm was here about 200 yards, and its direction about that of the line A, B.

We next repaired to a point where the destruction was reported to have been considerable, namely, to the farm of Mr. D. Polhemus, between two and three miles E. 17° N. from Mr. Garretson's. Here a very curious fact was developed, which I have attempted to represent in the sketch and ground plan figure 2, plate III. The building or shed attached to a large frame barn, and on the southern side of it, was moved during one part of the phenomenon to the west of north, and subsequently to the eastward. The posts (see b, figure 2) slipped from the stones, a, which supported them, when the building was first acted upon by the storm, and being carried northward and westward ploughed a furrow, c, in the soft surface of the ground, heaping up the manure, d, before them. Afterwards, being moved eastwardly, they formed another furrow, e, and a heap of manure, f, remaining in the position, b, when they were pointed out to us. As the first direction is nearly at right angles to that of the motion of the storm, the building being to the south of its axis, the conclusion is irresistible that there was, on the approach of the storm, a tendency to motion *towards* it. The second furrow shows a motion towards the receding storm. Why this building moved but in two directions, will appear from the protection afforded to the north east by a large barn, the strength of which enabled it to bear the tendency towards the moving meteor, without much injury. In figure 3, D is the shed, C the barn, and F G the probable direction of the storm, the probable axis nearly coinciding with that line. It is believed that the relative positions of the buildings there shown, are nearly correct; no particular pains were, however, taken on this score, a survey of the orchard to the east of the house, being the main object.

Of the trees in this orchard, figure 3, more than two-thirds suffered; being generally torn up by the roots. Of these there are two lying actually west of north, and seven thrown to the north of north-east; while the greatest amount of devastation is in the direction of the meteor, which passed over the western part of the orchard, the inclination of its path being about 10° N. of E. It is remarkable that some small trees, as n and o, were left standing, and were not much broken. Some large trees, as between s and g', were also left. The former ones had probably sufficient flexibility to give way to the action of the storm without breaking; c', b', a', f', and z, were probably uprooted on the approach of the storm. The tree y, presents a curious case: it is broken into three parts, the middle one lies north, and

the two exterior ones are separated from it to the eastward and westward. It will be observed that the trees lying perpendicularly to the track of the storm, are not those furthest from the centre of that track.

While the trees on the southern edge of the storm were thrown generally northward and eastward, the few which were on the north side, were thrown to the southward. Thus at i' is shown a large black cherry tree, uprooted and lying nearly parallel to the side of the house A, while at k' and l' are groups of willows, the limbs of which were broken off, and thrown to the southward and eastward. There were no trees in the meadow to the north of the orchard, and east of the group k'.

We were told by Mr. Polhemus, that the orchard of a neighbour to the west of him had been prostrated, but did not consider it advisable to return upon that point, determining rather to follow the track of the storm towards Brunswick. The general direction of Brunswick from Mr. Polhemus's house is E. 10° N.

We explored the wood belonging to Mr. Polhemus, and eastward from his dwelling, where the marks of the tornado were next to be seen. As, however, nothing of special interest was developed, I have not thought it necessary to copy the drawing made from my notes. Passing through this wood, the track was marked through fields of grain and orchards, in which the trees were uprooted, and near buildings which suffered more or less from its action.

The next point of interest occurred, where we distinctly made out that the meteor did not maintain its position at the surface of the ground; a fact which has been before observed in regard to other tornadoes. After a slight damage upon the edges of a thick wood of black oak trees, the marks of destruction were not seen until traced upon a ploughed field, to the east of the wood, in which there were a few trees. These were uprooted, and the moist earth from the surface of the field was thrown against the trees of an adjacent wood.

The next diagram, figure 4, represents a very remarkable case, establishing conclusively the direction of the forces already pointed out in figure 2, but in a case less complicated than the former.

In a tolerably open wood, we lost all traces of the storm, but pursuing a general easterly direction, came upon a part of its track where the trees were broken near the top. A little further on they were broken nearer to the trunk, and at last uprooted. A survey of the exterior of a circular space, around which the trees were overthrown, gave the accompanying representation, figure 4. The round was traced by the directions of the trees; that is, having set out at one point, I arrived at it again, by following the indications afforded by the directions of the trees. In the mean time Mr. Espy explored the interior of the round, and pointed out to me a space where the tops of the trees were lying together. The evidence of a rush towards a central space is thus conclusive.

To generalize the results of this diagram, it will be seen, that with a few exceptions to be remarked upon directly, all the trees on the southern border of the circular space A, are thrown northward; those

to the north southward; to the east westward, and to the west eastward.

These exceptions are probably to be referred, generally, to the forward motion of the spout. Thus, while c is thrown to the west of north, a tree beside it, and many like p to the south of it, were carried in the general direction of the moving column. The same is true of trees to the north of g and h. In selecting the trees to be noted, I took care to put down cases which seemed anomalous, lest something of consequence should escape observation. The irregular positions of the tops of trees at i, seem to be sufficiently explained by their interference in falling. The tree g may have had its top carried northward in falling, and lies almost directly opposed to the directions of trees to the north of it; these trees being bent permanently, but not broken. Pursuing the track of the storm along B C, the trees were thrown in its general direction.

Passing forward to the east, we lost the traces of the storm, and when they appeared again, the circumstances seen in approaching figure 4 were repeated. Figure 5 represents the recurrence of the effects produced by the descending of the column to the ground. I did not think it necessary to go round, with the compass, that part of the circle which is turned in the general direction of the motion of the spout, but merely the other portion which presents the curious circumstance of trees thrown in a general direction opposed to that of the motion, proving conclusively, that a rushing wind from the westward will not explain the effects. The fatigue incident to the previous work, made me very willing to cut off all that seemed of doubtful utility.

The next position surveyed, was at and around the dwelling of Mr. David Dunn. The destruction here was terrible indeed. The dwelling house had been unroofed, and otherwise severely injured. A large barn and stable had been torn down, the outhouses prostrated, and all the trees around the dwelling uprooted or broken to pieces. The storm had passed from an adjacent wood, about one-sixteenth of a mile to the west. All this destruction had been accomplished and an entire calm taken place, in the time that Mr. Dunn ran from the front to the back door of his dwelling, a distance of about thirty feet. This excessive rapidity of motion was no doubt one of the causes why lives were not lost, in vain attempts to escape from the effects of the storm.

Mr. Dunn received us with great kindness, and gave every information in his power, without expressing weariness at our curiosity. Indeed it is but justice to say here, that we met with uniform courtesy and kindness, along the whole route of our inquiry, and experienced no case where those whom we addressed were unwilling even to leave their work, to point out to us matters worthy of attention. For this attention we beg leave thus publicly to return our thanks.

A general glance at sketch figure 6, will serve to show that the trees near the house were thrown inwards. No case occurs in which the trees are thrown outwards from the house. Many, however, further to the north and east of the house, and which are not represented

in the sketch, were carried in the direction of the storm. A closer examination will serve to show several interesting particulars.

Of twelve trees in the row A B, south and west from the dwelling, all but three were injured, and generally uprooted. The three not injured were young black cherry trees, two were of "medium size," and the other quite small. Six of the trees were thrown between N. 4½° W., and N. W., or *towards the approaching spout*. Three were thrown towards the house, namely, the one nearest to the house, and two furthest from it: all these are large trees. Of the trees around the house, all those uprooted or broken, except *q* and *k*, point towards the house, and these were evidently caught by the trees to the west of them. *s'* presents a curious case: the tree was broken off, and the fragment carried towards the west; then, by a subsequent force, laid in the position *s'*, E. 7½° S. The tops of *m*, *n*, and *w*, were lying together in a heap, and the limbs from the trees in this group, together with palings from a fence to the west of the house, and fragments of the outhouse, C, were strewed at *x*. *u* and *t* have received their direction probably from the onward motion of the spout, which heaped an immense mass of rubbish against the west side of the house, breaking it in, and destroying nearly every article of furniture in the south-west room. The house, and the area just described to the north of it, seem to have been the scene of this inward rush. The facts to prove that it was also an upward one, will be stated by Mr. Espy. The trees in a field to the north of the house, and beyond *u*, *t*, *s*, *o*, were carried eastward in the general direction of the storm; and in a field still further north, the rafters from the roof of the dwelling A were found.

Two rows of trees extended from the south side of the house to the road. These do not appear to have suffered as much as the row to the west of them. In the nearest position of the spout, they were in part protected by the house. The trees which were uprooted lie in directions extending over the sector between N. 15° W. and N. 45° E.; much the greater number of trees being thrown between north and north-east.

A tree at *d'* was thrown against a small porch to the north of east of it.

As the destruction to the eastward of this house renders it improbable that the axis of the spout did not touch the ground there, it seems to me that this inward rush indicates that the spout had its velocity *momentarily* checked at this point.

On the following day we examined a wood to the east of Brunswick and on the opposite side of the river Raritan. This wood is to the east of the position examined by professors Henry and Johnson, from which the debris inspected by them had been removed.

The case here presented was so complex, that I doubt much if we could have unravelled it without previous preparation. The irregularities encountered on the southern edge, see diagram figure 7, detained me so long, that I was only able generally to sketch the northern borders, the directions of the trees being, however, still taken with the compass. The inward direction of the forces is here well made

out, notwithstanding the confusion produced by the subsequent forward rush of air. While I was engaged in obtaining materials for this sketch, Mr. Espy penetrated further west into the wood and beyond it. He states that the marks on the trees indicate a downward motion of the spout at this place, more obscurely made out than in the other cases before described. The nature of the ground to the west of the wood was unfavourable to an exact determination of this point, but it is probable that the spout was raised, for a short distance, above the surface of the ground.

As far as the examination of the different diagrams has shown, I think it entirely made out that there was a rush of air, in all directions, at the surface of the ground, towards the moving meteor; this rush of course carrying objects with it; and that the meteor did not always extend to the surface of the ground, and when at the surface did not move uniformly either in velocity or in direction.

In figure 1 there is no motion towards the approaching meteor exhibited; and this appears generally to have been the case along its track when moving uniformly and reaching to the surface of the ground. The reason of this readily appears, for the air in front of it would hardly be in motion, the trees carried by it hardly bent, before the second and more violent action would prostrate them in the general direction of the motion of the meteor.

Figures 2 and 3 exhibit cases of this motion in both directions, towards the approaching and towards the receding meteor. But there is no evidence here that the spout was not moving along the surface. In the case of figure 2, the motions were registered by the effects upon the ground, and the easily uprooted trees shown in figure 3, fell in directions, with one exception, between 10° W. of N. and 3° N. of E.: the meteor moving about 8° N. of E., and to the north of the orchard containing the trees.

The disappearance of the track of the storm is first satisfactorily made out in the remarks subsequent to those upon figure 3. The effect of a second case of the sort is represented in figure 4, where around a circular space, in which the tops of the trees were found lying together, is a ring in which the trees generally point to the central space. At the outlet, where the storm moved on its track, the trees are found in the ordinary directions, and the same is true to the eastward of the place in which this descent of the spout occurred.

A second case of the same kind is represented in figure 5. At Mr. David Dunn's, the evidence is against such a descent having taken place at the dwelling-house, as shown by the row of trees to the south and west of the house, see figure 6, and by the fence, trees, and shrubs of the garden to the west of the house. Yet the dwelling appears as a centre, towards which objects to the north and east of it were thrown. To account for this I have supposed a momentary, and the evidence shows that it was merely momentary, pause or check in the velocity of the meteor. Such pauses were represented to us by many spectators to have taken place, and sometimes in cases where they could hardly have been deceived. In figure 7 is shown a case in which it

is doubtful whether the effects are those of a check of velocity, or of a descent of the spout; most probably both took place.

These effects all indicate a moving column of rarefied air, without any whirling motion at or near the surface of the ground.

References to the Diagrams on Plate III.

FIGURE 1.

Wood of Mr. M. S. Garretson.

a. Tree uprooted,* N. 20° E.
b. Broken off, lies N. 10° E.
c. Hickory torn up by roots with a sapling alongside, N. 38° E.
d. Top of a black oak blown off, carried to E. 40° N.
e. Hickory broken off about two feet above the root, lies E. 1° N.
f. Black oak broken off at the root, E. 41° N.
g. E. 15° N., about thirty yards from the north edge of the storm.
h. The south east corner of Mr. Garretson's house bears W. 3° S. from this point.
i. A sapling bent over and kept in place by other trees, E. 30° S.
k. A sapling bent to E. 36° S.

FIGURE 2.

Outhouse of Mr. D. Polhemus.—Ground Plan.

a. A flat stone, on which the post b originally stood.
b. Present position of the foot of the post.
c. Groove made in earth to northward of a, by the post.
d. A mound of manure heaped up at the end of the groove c.
e. A second groove north of east in direction.
f. A mound, heaped up by the post b two feet high.

FIGURE 3.

Grounds of Mr. D. Polhemus.

A. Dwelling house of Mr. Polhemus, slightly injured.
B. Outhouses not injured.
C. Barn, shingles torn off, not many in number.
D. Shed shown in figure 2.
E. Open work corn crib, not injured.
a. N. 12° E. Uprooted.†
b. Tree uprooted, too crooked to determine its direction.
c. N. 6° E.
d. N. 27½° E.
e. E. 20° N.
f. Tree standing near the fence.
g. E. 6° N.
h. E. 8° N.
i. E. 3½° N.
k. E. 18½° S.
l. E. 25° N.
m. E. 18° N. Tolerably straight. Shingles from barn, found at the foot of m. South-east angle of the barn bears W. 30° S.
n. Tree standing.
o. Low tree standing: small.
p. N. 32° E.
q. Broken, not uprooted.
r. N. 27° E. Dead: bushy.
s. Standing. High and stout.
u. N. 24° E.
v. Plum tree near, standing.
x. N. 5° E.
z. N. 9° W. Small, firmly rooted in north side.
y. Thick and bushy: broken off into three parts, the smallest of which points west of north, the next north, and the largest east of north; the bark is stripped off below the fracture.
a′. N. 4° E.
b′. Same general direction as a′.
c′. N. 2½° E. Small roots.
d′. E. 22° N. Very large roots.
e′. N. 10° E.
f′. N. 10° W. A small tree near this, in the same row is untouched.
g′. E. 35° N.
h′. E. 3° N. Three trees at the south end of the row f′ g′ are standing.
i′. A very large black cherry tree, uprooted, and lying nearly parallel to the house.
k′, l′. Groups of willows, the limbs and branches of which are torn off, and thrown to southward and eastward.

FIGURE 4.

A Wood.

a. N. 40° E. Uprooted.
b. N. 35° E. Several in the same general direction.
c. N. 29° W. The top of a tree has fallen on c, and nearly at right angles to it.
d. W. 12° N. Uprooted.
e. W. 42½° N.
f. W. 13° N.
g. W. 4° N. It lies N. 15° W. from e, and about one-eighth of a mile from it.
h. S. 23° W. One of the last trees near the edge.

* The trees are uprooted unless the contrary is stated, or shown in the figure.
† The directions of the arrows indicate those of the trunks of the trees.

i. Top blown E. 36° N., large end foremost. Another top at right angles.

k. Top blown off E. 0½° S.

l. E. 7½° N. A tree near l is broken off and top lying to west, obviously could not go to eastward on account of the other trees.

m. N. 23° E.

n. N. 15° W. Many large and small trees, not varying in direction 5° from the direction in which this has fallen.

o. Is the same as a. Being at once the point of departure and of termination. b was also examined and identified.

References to the Diagrams on Plate IV.

FIGURE 5.

A Wood.

a. E. 35° S. Tall hickory broken off about fifteen feet from the root.

b. S. also broken.

c. S. 31½ W.*

d. W. 9° N. Uprooted. A tree near to d is broken off and carried in the same general direction.

e. Broken off and carried W. 18° N. A tree near to this and west of north of it, carried in the same general direction.

f. A large rotten oak broken off, lying W. 36° N. Its trunk at the base, fifteen feet from the fracture, measures six and a half feet in circumference.

g. A broken tree lying over f and nearly at right angles to it.

FIGURE 6.

Dwelling and grounds of Mr. David Dunn.

a. N. 40° E. A cherry tree. The west corner of the house is about one hundred feet off, and lies to N. 42½° E.

b. N. 20° W. A cherry tree uprooted.

c. Cherry tree of medium size unbroken.

d. N. 22° W. A large cherry tree uprooted.

e. N. 19° W. Uprooted.

f. Small cherry tree standing.

g. Large cherry tree N. 4½° W.

h. Cherry tree of medium size, unhurt.

i. N. 10° W.

k. Black cherry tree N. 13½° W.

l. N. 23½° E.

m. Largest cherry tree in the row, N. 10½° E.

n. Large pear tree.

o. Broken off and cut since the storm.

p. A small tree standing. A tree on the opposite side of the road is broken off, and the broken part lies to the northward.

q. A large black cherry tree lies N. 15° W.

r. Not taken.

s. Broken seven feet from the ground, and has fallen against t.

t. Not taken.

u. A large black cherry tree N. 18° E.

v. E. 30° N. Large black cherry tree, torn up and thrown from its bed.

w. N. 40° E. Black cherry tree.

x. N. 3° E. Smaller cherry tree.

y. N. 18½ E. Largest size.

z. Broken to north east.

y′. Standing.

x′. Broken.

a. N. 3° E. Very large black cherry tree.

b. Small tree not injured.

c. Larger than *b* not injured. Small.

d. Uprooted N. 45° E.

e. Small.

f. Medium size cherry tree. Not broken.

g. Broken limbs to east. A black walnut (?) tree.

h. Cherry tree broken.

i. Pear tree uprooted.

k. N. of house. W. 4° S. Small fruit tree fallen against *l*.

l. Stripped of leaves.

m. Pear tree uprooted, points, as shown in the figure, towards the house.

n. Ditto.

o. *p*. Broken fruit trees. Small.

q. Broken off and lying against *r*.

s′. Is the position of the broken part of *s*. It lies E. 7½° S.

t. Large pear tree, pointing as shown in figure.

u. Points to about ten feet east of the wash-house B. It is a broken apple tree.

v. Broken pear tree, coated with dust on the north west side.

w. Large cherry tree broken off E. 27½° S. Its top lies with those of *m* and *n*.

x. A pear tree. Broken.

y. A black cherry tree, uprooted and thrown against z. Lies in the line *y z a′*.

z. Black cherry tree, dirt on the north east side of it. Broken on that side, its limbs lie parallel to the house.

C, D. Two outhouses to east and west of *z*. The timbers of the eastern outhouse C, lie in the mass *b′*, which contains the tops of trees, &c. The windows of D are broken on the east, one on the west side is forced in. Clap-boards are off in part near the ground on the north side.

b′. A heap of rubbish left by the storm. Tops of trees *k*, *l*, *m*, &c., beams from C, &c.

c. A tree lying as shown in the figure.

* The trees to the directions of which the angles refer, unless when the contrary is stated, were uprooted.

d. To S. of house. A small tree broken and thrown against the porch H.

F. A fence to the west of the house prostrate, and in part carried against and into the west side of the house. All the trees and shrubs which were in this garden, are prostrate or broken.

FIGURE 7.

A wood to the east of New Brunswick.

b. N. 26° W. Two oaks close together, uprooted. Trees to N. 26° W. of *b* lie in the same general direction.

c. E. 9° N. Trees near c and to west of b lie, some directed as c, others as b.

e. E. 36° N. A small oak, which may have been deflected by the trees against which it has fallen.

f. Three trees, smallest N. 38½° E. The largest has possibly been deflected by the trees against which it has fallen: it rests N. 18½° E. One to the west of the other two is rotten; it lies N. 3½° W. Smallest and largest not wholly uprooted.

g. N. 16½° E. Uprooted. A tree to the south of this inclines to the east.

h. E. 40° N.

i. W. 18° N.

i′ Two small trees uprooted, lying under i, N. 3° E.

k. Broken. Its top lies N. 10½° E. from the trunk. Crooked.

l. N. 6° E. The top of an oak. Broken off.

m. Top off. E. 32° N.

p. N. 16° W. Three oaks uprooted.

q. N. 30° E.

q′. to N. and E. from q. Broken, N. 35° E.

r. Two oaks uprooted, E. 36° N.

s. N. 23½° E.

t. N. 32½° E. Several others not 10° from this direction.

v. A broken oak, N. 44° E.

w. Top broken off and carried to north east. Direction of the stem of top N. 20° E.

x. N. 26° E.

y. N. 10° E.

z. Top carried to N. 39° W. Some trees near, lie to N. 40° E.

a. Lies S. 2½° E. Another, near it, is in the same general direction.

b. Nearly south. A rotten stump.

c. A sound tree broken to S. 35° W.

d. Uprooted to S. 36° W. Many like this to the east of it.

e. S. 28° W.

f. S. 14° W. This tree is north of the point a.

g. S. 12° W.

h. Very nearly S. 3° E.

i. S. 6½° W.

Trans. Amer. Philos. Soc.

[TO BE CONTINUED.]

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. Boucherie, M. D.

On the Method of Penetration.

[CONTINUED FROM PAGE 185.]

After having determined the substances which were most efficacious in preserving wood, I had to seek for the means of introducing them deeply into it. The method which I sought was not only required to be complete in its scientific results, but it ought also to unite the conditions of quickness and economy indispensable to its application to the arts.

I first satisfied myself by numerous experiments upon different kinds of wood, plunging them into different liquors, that maceration, unless it was exceedingly prolonged, introduced the materials only to a very slight depth.*

I then turned my attention to mechanical means, and not knowing

* Wood plunged in saline solutions yields to them a part of its soluble matter, which forms combinations with the liquid outside of the mass, thus occasioning the loss of a part of the preserving substance, which we should always study to save.

In some experiments with salts of iron, I have seen my solutions pass into the state of a true mud.

PLATE III.

Fig. 1.

WOOD of Mr M. S. GARRETSON.

Scale as of fig 4.

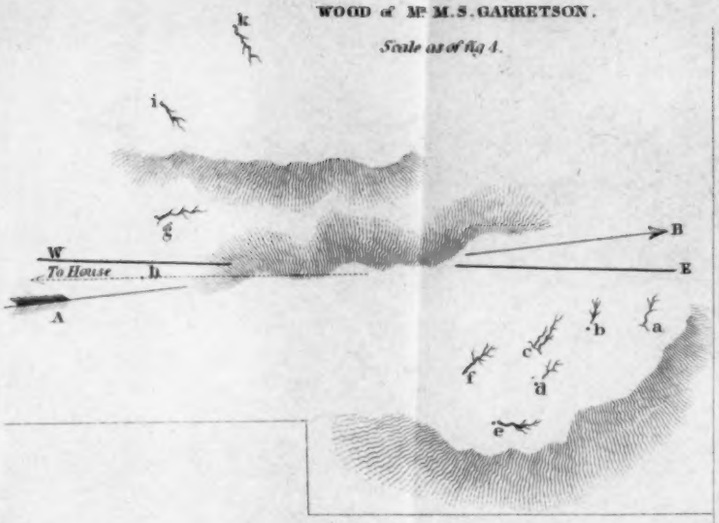

Fig. 2.

OUT HOUSE of Mr D. POLHEMUS.

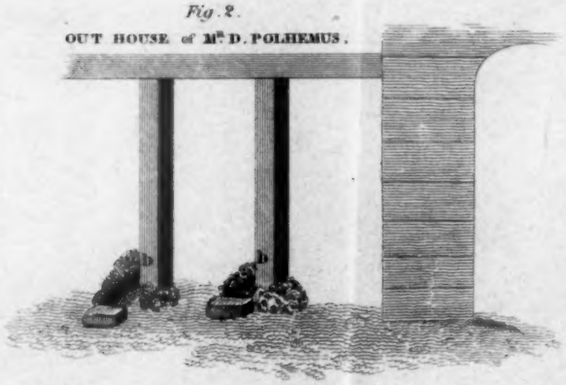

Fig. 4.

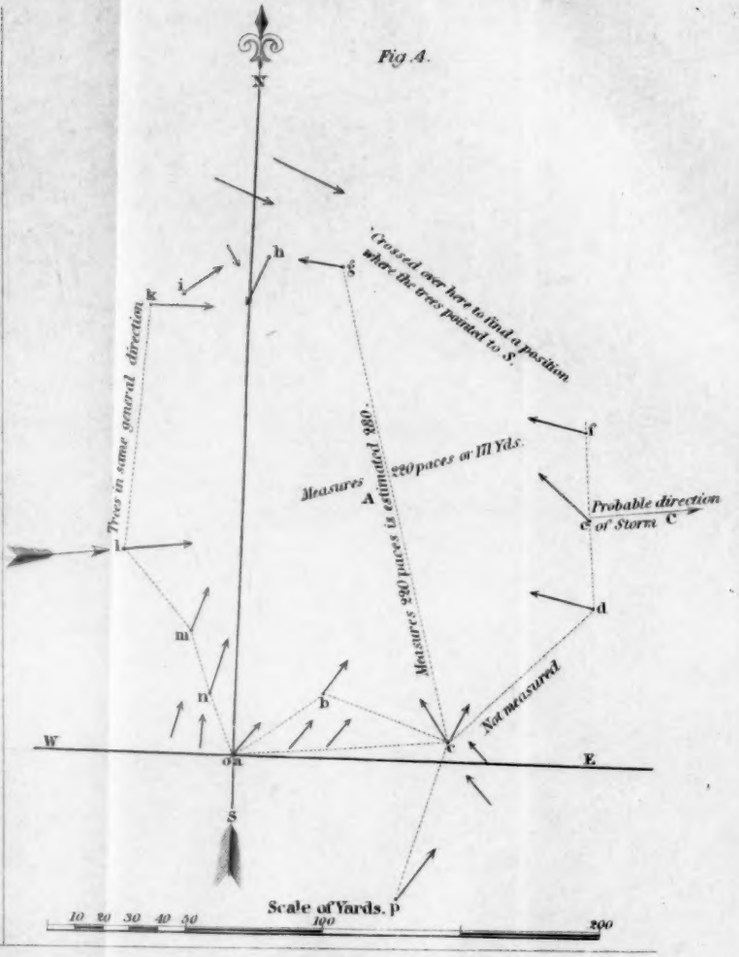

Fig. 3.

DWELLING &c. and ORCHARD of Mr D. POLHEMUS.

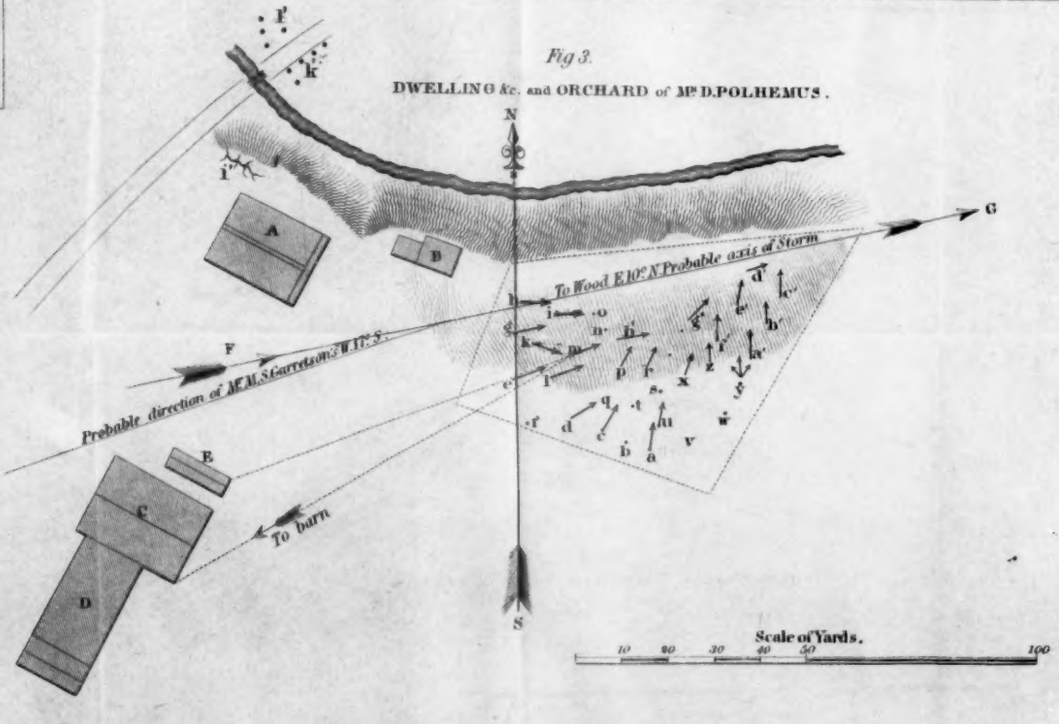

PLATE IV.

Fig. 6.

DWELLING & GROUNDS OF Mr D. DUNN.

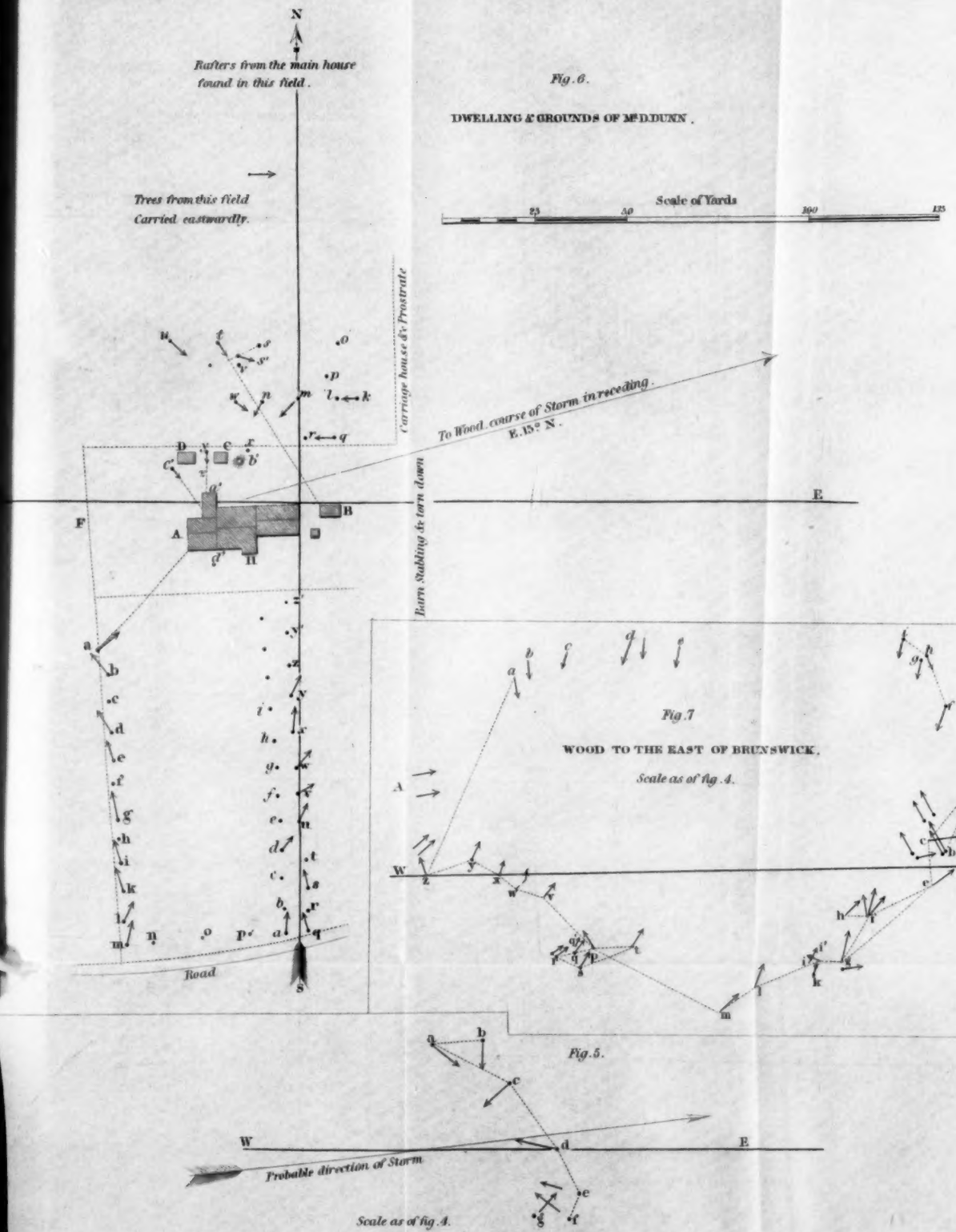

Fig. 7

WOOD TO THE EAST OF BRUNSWICK.

Scale as of fig. 4.

Fig. 5.

Scale as of fig. 4.

of M. Breant's ingenious machine, I caused several imperfect apparatus to be constructed, from which I obtained no satisfactory results.

I succeeded no better in rarefying, by a regulated heat, the air included in the interior of the wood, and then plunging it at once into the solutions which I wished to introduce. By this method of operating, however, I succeeded in causing different liquids to penetrate various materials used in construction, of a very compact nature—thus I succeeded in introducing tar into stones and bricks to a great depth.

This want of success did not discourage me, and being possessed with the rational idea that it ought to be infinitely more advantageous to act upon wood in its green state, than to prepare them, after the time necessary for their complete desiccation had sensibly altered them, I began to inquire whether the force which determines the circulation during the life of the tree, did not continue after it was felled, and whether I could not employ this as an introducing agent, in order to penetrate the mass of the tree by different matters fitted to preserve it and give it new properties. I undertook some experiments in reference to this, and the success answered my hopes; I succeeded, in short, in discovering an infallible method of introducing into the very tubes which contain the alterable matters, substances which, by rendering them insoluble, prevent their decomposition and destroy their nutritive properties.

I was not aware at the time, of any examination directed to this fact. Since then, I have learned that experiments had been formerly made upon fresh plants, and young branches, in order to determine the course of the sap by the absorption of coloured vegetable solutions. These experiments were purely scientific, and before the development of the facts of which I am now about to treat, the fundamental idea had never occurred to any one of taking advantage of the vital force of plants in order to use it as a beneficial force, by the aid of which we should be able to introduce almost into the integral particles of the wood, certain matters which possessed the power of preserving it, and of giving to it new properties.

The following is the fact upon which my process is founded.

If we cut a tree of great height, and immerse the foot of it, within a suitable time, in a saline solution, whether weak, or concentrated, a strong absorption is exercised by the tree upon the liquid, which thus penetrates the tissue, and soon reaches the highest point of the stem, and even the terminal leaves, if we are careful to furnish sufficient quantity of the liquid.

Thus in six days, in the month of September, a poplar tree, ninety feet in height, and fifteen inches in diameter, the foot of which was immersed only eight inches into the pyrolignite of iron, at the temperature of eight degrees, was entirely impregnated by the liquid, of which it absorbed the enormous quantity of three and a half cubic feet.

Seeing the numerous applications of this new principle, I varied my examinations and experiments in a thousand different ways. I operated upon all the different varieties of trees which I could pro-

cure, at different seasons of the year, and with a considerable number of liquors of different natures. In the course of these researches I developed some curious facts, of the highest interest in vegetable physiology, the most obscure parts of which they illustrate. Not desiring to speak of intervascular penetration, except in reference to its applications, I reserve for another memoir, which I shall soon offer to the Academy, the facts relative to the internal organization of wood, its diseases, the course of the sap, &c. &c.

In order to give greater clearness to my observations, I shall divide this part of the work into paragraphs, upon each of the details of the process.

I. On the means to be employed to effect the impregnation of wood in the most economical manner.

In my first experiments, I raised up, by suitable means, trees which had been sawed off at their foot, and immersed their base in receptacles full of the liquor which I wished to introduce. The absorption was effected perfectly, but in regard to the quickness and economy of the work, there were great inconveniences in proceeding in this way, because the weight of a green tree of large diameter, is very considerable, and it requires not only powerful means to raise it up, but we must also find a strong resting-place to support it; but this resting-place can often be found only at a considerable distance from the tree which we wish to prepare. To overcome this difficulty, I examined whether the absorption did not go on equally in all positions of the plant, and finding that it was always equally strong, I decided to operate upon the tree whilst upon the ground; adapting very accurately to its foot a bag of water-tight stuff, which answered the purpose of a reservoir. In this way, I operated very many times with great success.

Afterwards I began to inquire whether I could not prepare a tree, whilst standing, by excavating a hollow in its trunk, and putting it, by suitable means, in communication with the reservoir filled with the liquid. In this way, I succeeded remarkably well, and by varying the nature of the liquids, and by multiplying the cavities for the reception of each one, I was enabled to impregnate the same trunk with different substances, and to produce the most varied results. I do not, at present, dwell upon this order of facts, which may, some day, become of importance, I will only remark that by this method of impregnation, the liquids are introduced, upwards and downwards, into all the sap-vessels, which have been opened, with this difference, that in an upward direction the column penetrated preserves its breadth to a very considerable height, whilst downwards it diminishes rapidly in advancing towards the roots.

I then sought to simplify this mode of preparation, and to render it more complete in its results, and in order to succeed, I adopted a new process, which has given me, already, excellent results. It consists as follows. After having stripped the tree of such of its branches as experience has taught me are not indispensably necessary to cause a strong absorption, I pierce it through and through, in the direction

of its greatest thickness, by means of an instrument, which bores a hole of three-quarters of an inch in diameter; into this hole I introduce a saw, which enables me to extend the opening in a line, to within about one inch of the surface. I thus open up the greater part of the sap-tubes of the stem, and nevertheless, leave sufficient upon two opposite points to sustain the tree in its vertical position. This being finished, I cover all the open parts with cloth covered with tar, which I fix firmly to it, and adapt to one of the circular openings, which I take care not to choke up, a tube which communicates with the reservoir.

II. Is the absorbing force the same at all seasons of the year: or does it vary in each of them, according to the kind of tree which we are examining?

My position has not enabled me to combine a sufficient number of observations to arrive at the whole truth upon this subject. I can only present a small number of facts, which show how interesting the general study of it will be, and to what unhoped-for results it may lead us.

In general, winter is a season of repose for the vegetable circulation; but in no case is this repose complete in any species. I have convinced myself of this by experiments made upon oak, hornbeam, and sycamore, in December and February; I have seen, in the cold months, the liquids mount several feet, but never to so great a height as during the spring, summer, and autumn. Of these three latter seasons, the spring appears the least favourable for a complete impregnation, and the autumn has given the best results.

This fact is in contradiction to every thing which has been admitted heretofore. Botanists, in fact, consider the spring as the epoch of the year in which the movement of the sap is most active. This arises, probably, from not having made any distinction between the movement of the sap at the surface, and its movements in the interior of the tree.

I have reason to think that these movements do not take place at the same time, and I may present, in support of this opinion, some confirmatory facts. But the result to which I am led by them differs so far from that which has heretofore been adopted, that I fear I have mistaken them. I am now busy in repeating my experiments, and if, when varied, they confirm and illustrate that which I have already observed, I will record them in another memoir, which I propose to present to the Academy.

A remarkable exception to this law, which regulates the movement of the sap, presents itself. It is presented by those resinous trees which preserve their foliage green until spring, because in them the circulating movements are preserved during the winter. I have proved this fact by experiments made upon these trees in December, and in the first days of January; I have always been able to impregnate the whole of their trunks at this season of the year. This fact ought to have been known before-hand, since the permanence of the fresh and green state of the leaves, which always have a tendency to

dry up, and then to fall, could only be caused by their constantly receiving liquids which the movement of the sap alone could carry to them.

But although the movement of the sap in this class of trees is prolonged much later than in other species, its re-appearance, after it has ceased to exist, is much more slow.*

I have observed that this new, yearly, and deep-seated circulating movement had not yet shown itself in June, and it was in confirming this fact that I discovered another, which I think worthy of mention.

Upon the 25th of May, 1839, after cutting a pine in bud† of eighteen inches in diameter, and of a great height, I suspended it to a neighbouring tree; I dipped its lower extremity into a reservoir full of pyrolignite, and I suffered the experiment to continue for eight days. When this time had elapsed, I was not a little surprised to find that the level of the liquid in the reservoir had scarcely fallen. I felled the tree, and upon examining it, by cutting in at different points, I found that, in general, it had absorbed nothing, even at its lowermost parts, but that for a thickness of one inch, and to an extent of forty feet, the face which looked towards the south-east was well impregnated. This fact, besides demonstrating that the sap is but slowly put in motion in the pine, renders evident the influence of exposure, which had been before remarked, and accounts also for the greater development which is generally presented upon that side of the tree which faces the south-east.

III. Is the absorption more active and energetic, in proportion as the tree is more vigorous, its branches more numerous, and its foliage more abundant, and better developed?

In a practical point of view, it was interesting to determine whether all the branches were indispensable for effecting the impregnation: for if it was found that they were not necessary, it became possible to remove isolated trees to a central place, in order to prepare them there. I have assured myself, by several experiments, that the greater part of the trunk of a tree can be penetrated, notwithstanding the removal of almost all of its branches. The terminal foliage of the tree must always be preserved.

IV. What time may be suffered to elapse between the cutting and the preparation of the tree, preserving always proper conditions for the penetration?

This time varies with the season of the year, and the species of tree. At the end of September, a pine tree, sixteen inches in diameter, was not dipped into the liquid until forty-eight hours after it was cut, and nevertheless, was perfectly impregnated. In June, the same result took place with a sycamore tree, which had been cut thirty-six

* The movement of which I speak is that general movement which permits the introduction, to a great depth, of the liquids which are presented to the base of the tree; it must be carefully distinguished from that which converts the buds into leaves, and furnishes nutriment to all the spring-shoots. This latter movement exists in the pine as early as the month of April.

† Pin gemmé.

hours. Having at my disposal but a small number of trees, I did not wish to run the risk of waiting longer; but it is probable that even after a longer delay, I should have been able to impregnate, if not the whole length of the tree, (which is never of any use,) at least so much of it as is useful in building.

In all cases, the sooner we commence operations, after the cutting, the stronger is the absorption. It decreases rapidly after the first day, and is generally scarcely sensible upon the tenth day. These ten days are sufficient for a complete impregnation when we operate under favourable circumstances. In some cases I have observed that in seven days the liquor has risen to from 90 to 100 feet. The experiment was made upon a poplar.

V. Are the quantities of different liquors, which can be introduced in this way, considerable? Is the absorption of neutral liquids more abundant than that of acid or alkaline solutions?

Of all the secondary facts which arrange themselves around the primary facts of absorption, and are the consequences of it, this is the most remarkable. The quantity of liquors introduced is really enormous. A sycamore tree of one foot in diameter, absorbs, in seven days, nearly ten cubic feet of chloride of calcium, at fifteen degrees, and a tree of the same kind, in the same space of time, dried up a reservoir which contained seven cubic feet of pyrolignite of iron, at 6° Fahrenheit. With other species I obtained similar results, and always with quickness when I operated under favourable circumstances. Apriori these remarkable facts could not have been anticipated. Every thing would have induced us to believe, on the contrary, that the vitality of the vessels would be diminished by the contact of liquids so different from those which they ordinarily convey, and that the consequence would be the stoppage of the absorption. Experiment has shown that this is not the case. But let us cite more precise results.

Upon the 5th of August I dipped the extremity of a sycamore branch in chloride of calcium, (muriate of lime,) at 15°. At that time it weighed 2620 grammes—having finished the experiment upon the 13th, I found that it had absorbed 2000 grammes of the chloride, and its weight was reduced to 2466 grammes.

A second experiment, made also on the 5th of August, upon sycamore, gave me similar results. The branch weighed 2880 grammes at the commencement of the experiment; upon the 13th, it presented the same weight, and had absorbed 2430 grammes of chloride of calcium. A third branch of sycamore, weighing 4000 grammes, had absorbed, in eight days, only 880 grammes of pyrolignite, at 8°. In this case the absorption of the pyrolignite was relatively much less than that of the chloride of calcium. Every thing leads us to believe that this result is due to the fact, that acting as an astringent this salt contracts the vessels, shrivels them in some way, and thus materially diminishes their capacity—the horny state of the leaves, (*raccornissement,*) which is always seen, indicates an action of this kind, which

is never seen when we operate with chloride of calcium.* In this latter case, on the contrary, the leaves remain soft and flexible, even after being left to themselves for two years.

The size of the molecule of the body which we wish to introduce, certainly plays a remarkable part. It would, perhaps, not be impossible to measure it comparatively, by presenting it to the absorbing action of different kinds of wood, and a success of this kind would open a new scientific path, and offer to analysis a method for the perfect separation of bodies, which, heretofore, we have only been able to study after they have undergone a change in their nature, brought about by the means used to isolate them.

In order to determine the quantities of different substances absorbed, I repeated the weighings, of which I have just spoken, a great number of times, and always obtained similar results for the same species of trees. The same materials have always been absorbed in great volume, or always in but very small quantities. The neutral salts have always been found in the first class, and all acid and alkaline salts in the latter.

In order to determine the relation existing between the quantity of matter introduced into the branches, and that absorbed by the trunks of the trees, I had recourse to the incineration of these different parts, and thus assured myself that the differences were very trifling.

[TO BE CONTINUED.]

Metallic Relief Engraving.

Take a tablet of plaster of Paris, and, having heated it, apply wax for absorption to all the faces, save that on which you intend your drawing to be, and to that one apply your drawing, executed with lithographic ink, on lithographic transfer paper. Let the side of the tablet on which is the transferred drawing, be now dipped in weak acid and water, and then permitted to absorb a solution of sulphate of copper. By electro-metallurgy a deposition of copper can be made on all parts stained with the sulphate. Ere this coating be too thick, let the tablet be removed from the vessel in which this last operation has been carried on, washed *carefully*, dried, and a mixture of isinglass and gin be poured on it; its redundancy be gently blotted off with blotting-paper till the surface be level (*i. e.* the copper lines and isinglass cement be of the same height:) again, let the deposition take place, and again its succeeding operation; after which let common

* I will here remark that the modifications which the leaves present, under the influence of different re-agents absorbed by their stem, enabled me to measure, with great accuracy, the poisonous properties of different substances. Thus having plunged branches of poplar of the same size, taken at the same time from equal heights upon the same tree, into vessels containing water, the chlorides of calcium and sodium, pyroligneous acid, sulphuric, hydrochloric, and arsenious acids, and the sulphates of zinc, iron, and copper, and the deutochloride of mercury, I observed that the absorption of the five first liquors continued to go on, by the aspiration of the leaves, which remained healthy, whilst in the other solutions the absorption had, for a long time, ceased in the branches, the leaves being faded and withered.

black lead be rubbed over the whole surface; and the deposition being renewed, a copper mould, from which a type metal block may be subsequently cast, is now formed.—*Another method.*—Draw with a pen dipped in warm isinglass coloured cement, and when your drawing is dry, for an instant expose it to steam, and then coat it with leaf gold. Proceed by electro-metallurgy, as in last method, and no cast is necessary.

Athenæum, Feb.

Electrotype.

M. Kobell, of Munich, presented some engravings through M. Brongniart to the French Academy, which were produced by a modified process of his own. Upon a well polished plate of copper, or silver, he executes a painting of the subject to be engraved. The colour which he employs is oxide of iron, pounded with essence of turpentine, and mixed with a certain quantity of the same essence thickened by standing, or, what is equally good, with a solution of the resin of Dammera in the essence of turpentine; he sometimes adds formate of silver. This painting is obviously monochromous, and the variety of tints is produced by the different thicknesses of the colour applied upon the plate of silver; so that the lights are given by the metallic surface, and the half tints and the shades by the greater or less thickness of the colour. When the painting is well dried and adherent to the plate, it is to be deposited in an electrotype apparatus, in order to receive the deposit of copper, which takes place immediately upon the parts not covered by the painting, more slowly upon those which are only covered by a thin layer, and more tardily still upon those parts where the thickness is greatest. After several successive applications, when the thickness is sufficient to support the action of the copper-plate press, the deposit is to be separated from the plate, and the former, if any remain adherent, may be disengaged from the painting, by washing with ether; we have then a mould of the painting, executed in relief upon the silver plate; and we may conceive that if we take an impression by the ordinary copper-plate press, the colour deposited upon the paper will possess the thickness of the original painting, and will be faithfully re-produced.

Ibid, Dec.

Distinguishing Signal for Steamboats.

The inventor is Mr. Francis Melville, who, from a praiseworthy desire to promote the general safety, has devoted much of his time to the subject. Mr. Melville's plan is to place in front of the funnel of the steamer a lamp, with a clear light, and a strong reflector, having an external sliding cover attached to its face, so fitted as completely to obscure the light within, but to be made to move up and down the whole length of the lantern by means of a rod affixed to a small lever power connected with the engine, so that the motions or alterations of the slider would be at the rate of twenty in a minute. At the bottom is to be added a flat sole, made so as to carry the rays of light